JOURNAL

OF THE

FRANKLIN INSTITUTE

OF THE

State of Pennsylvania,

DEVOTED TO THE

MECHANIC ARTS, MANUFACTURES, GENERAL SCIENCE,

AND THE RECORDING OF

AMERICAN AND OTHER PATENTED INVENTIONS.

JULY, 1830.

AMERICAN PATENTS.

LIST OF AMERICAN PATENTS WHICH ISSUED IN APRIL, 1830.

With Remarks and Exemplifications, by the Editor.

1. For an improvement on a *Machine for Spinning Cotton*, known by the name of "Danforth's Patent Throstle;" Charles Danforth, Patterson, New Jersey, April 1.

The machine upon which this is an improvement, was patented September 2nd, 1828, and in our list is denominated an "Improvement in the Construction, Manufacture, and management of the Bobbins and Flyers for Spinning Cotton." We did not publish any account of the plan of this apparatus at the time, from the wish of the patentee that it might be delayed, as he then contemplated securing his right in Europe, which a publication here might have defeated.

On the 31st of March, 1828, a description of some improvements in spinning was received at the patent office, from Mr. John Thorp, of Providence, Rhode Island, and a patent for these improvements was subsequently obtained by him. The description referred to will be found at page 41, of the last volume. The patent obtained by Mr. Danforth, in September, 1828, was for an improvement bearing a strong resemblance to that described, and afterwards patented by Mr. Thorp; Mr. Danforth has obtained the present patent for a further improvement on his first mode. We shall not attempt to enter into particulars respecting the arrangement devised by Mr. Danforth; its general object will be understood by the re-

ference already made; more would require drawings. The question of who was the first inventor is one which we are not prepared to discuss, as it belongs to another tribunal.

---

2. For a mode of making *Woollen Roping, or Slubbing*, by the "Spiral Slubbing Machine;" Austin Steele, Waterbury, New Haven county, Connecticut, April 1.

The main cylinder, doffers, combs, and small rollers, in this machine, are represented exactly like those in the drawing accompanying Mr. Charles Atwood's specification, page 378; but instead of the tubes between the doffers and small rollers, the wool, as it is separated by the combs, is received upon a short revolving apron; it passes along this apron, across which "is another apron, or belt, which presses upon and revolves on the said web, and rolls, or twists it; or a roller, working obliquely, may be used for the same purpose. The effect produced by the motion of the upper apron or roller, is to twist or roll up the roping or slubbing spirally." The claim is to "the mode of making woollen roping, or slubbing, by rolling it up spirally, as above described." Mr. Atwood refers to this mode of rubbing, and objects to it, as producing a degree of felting injurious in the subsequent operations upon the slubbing, and upon the fabric manufactured from it; so far as we may be allowed to judge without experience, we are inclined to prefer Mr. Atwood's plan.

---

3. For a machine for *Thrashing all kind of Grain*, called the "Paragon Thrashing Machine;" William C. Ross, Penfield, Monroe county, New York, April 1.

The novelty and merit of this machine depend upon the "placing the apron on an inclination, and reducing the motion of the main, or thrashing cylinder, and consequently reducing friction, &c."

The main cylinder is of wood, covered with iron, or furnished with six beaters, also covered with iron, to protect them against wearing.

"The improvements relied on in this machine, are, in adding to the diameter of the main cylinder, consequently producing the same effect with half the revolutions, thereby reducing the friction, which the *inventor* considers the most *discriminating* feature of its utility; in the inclination of the apron; and in the *conciseness* of the machine and its appendages. I therefore claim all the above improvements, together with the privilege of varying the dimensions and proportions of the improved thrashing machine, as my fancy may from time to time hereafter dictate, so that all the while I adhere strictly to my principle, and depart not from it." Which *principle* is the making the cylinder twice as large as one of half the diameter, and *inclining* the apron by which the machinery is fed.

---

4. For improvements in the *Machine for making Dipped*

Candles; Thomas M. Scott, Falls Township, Bucks county, Pennsylvania, April 1.

The specification and accompanying drawing give a clear view of the mode in which the frame is to be constructed, for holding the rods upon which the wicks are to be placed; also the manner of placing the wicks, heating the vat, and managing the dipping. The patent is not taken for an individual improvement, but for a general system, the explanation of which would require the drawings. It is calculated for a large manufactory only, and in this age of lamps and mould candles, we apprehend that but few persons will feel a particular interest in the subject.

---

5. For an improvement in *Horse Shoes;* Sumner King, Sullivan, Madison county, New York, April 1.

The improvement designated is the making the caulks, or projections, moveable, instead of permanent; for this purpose the shoe is to be formed with an opening or mortise in the toe to admit the moveable caulk to slide in, when it is to be secured by a bolt, or screw and nut. "The hinder caulks may be fastened on in the same way, or they may be permanent."

"The caulks can be cast, or made of steel or iron, or any other metal."

"What I claim as my invention, is, the making of moveable caulks, or projections, for horse shoes, whether made of cast or wrought iron, or of any other metal as above described."

---

6. For a *Self-operating Temple;* Ephraim R. Otis, Lyme, New London county, Connecticut, April 2.

(See specification.)

---

7. For a machine for *Sawing Shoemakers' Lasts and Hat Blocks;* Seth Carsley, 2nd, Harrison, Cumberland county, Maine, April 2.

"This improvement in making shoe lasts and hat blocks, is a circular saw and a vibrating carriage, placed above a slide carriage; and an index and pattern, which govern the action of the saw upon the work; and a feeding screw which moves the slide carriage."

The foregoing is the whole of the specification, with the exception of three or four lines of reference to the drawing; the latter, however, is tolerably descriptive, and by the joint aid of imagination and invention, an idea may be formed of the structure of the machine.

This saw, we are led to suppose, is to operate as a rasp, or gouge, in roughing out a block; the block and saw are both made to revolve. The *guide* is in the shape of the article to be produced, and is made to revolve against what is rather strangely called the index, as it is a round wheel fixed to a sliding frame, which it causes to move so as to carry the block to be formed, against the saw, agreeably to the shape of the pattern.

8. For an improvement in *Propelling Boats;* Timothy Beach, Wilmington, Clinton county, Ohio, April 2.

We scarcely know how to designate the *improvement* in propelling to which the foregoing title alludes. We may safely aver, however, that in the multitude of devices which have entered into the heads of schemers, with and without brains, there is not one less feasible than this, excepting it be such as are constructed on the principle of the "upward forces of fluids," or some other equally allied to perpetual motion.

Tubes of metal are to pass through the water from the forward part to the stern of the boat, there being one on each side, as low down as the keel. These tubes turn upwards at the forward part of the boat, and open into a steam chest, connected with the boiler; into these tubes steam is to be alternately admitted, and cut off, by a sliding valve. When the steam is admitted, it is to drive the water out of the tubes, and propel the boat; when the steam is cut off, the water is to re-enter in readiness to be again ejected, *secundem artem.*

The claim is to "the application and construction generally of the above described machine."

---

9. For *Chain Paddle Wheels;* Andrew Rodgers, Middletown, Dauphin county, Pennsylvania, April 6.

Among the early attempts in constructing propelling machinery, plans precisely similar in principle, and in arrangement nearly the same, with the present, were devised and essayed. An endless chain in the middle, or one on each side of a boat, is to be made to pass from stem to stern by the revolution of wheels, around which they are strained. Between each joint of the chain is fixed a bucket, or float, in order that a row of them may act upon the water, horizontally, at the same time. The construction of the chain, the wheels, and other parts, in the present plan, manifest much skill, but still we see nothing in it which can secure to it the character of novelty, or remove the difficulties which have heretofore caused this mode of propelling to be abandoned.

The claim is "the construction of chain paddle wheels for propelling boats, as herein described."

---

10. For an improved mode of *Manufacturing Pill Boxes;* Nathan Crary, of Knox, and Edward P. Crary, of Bern, Albany county, New York, April 6.

We are not acquainted with all the modes adopted for making pill boxes, but those described in the present patent are so simple and obvious in their character, that we should apprehend that they, or others equally good, must have been long known and practised. Cylinders of wood are used for making round boxes, and their covers, and oval formers for those which are to have that shape; round these the chip is bent for the purpose of glueing it. These moulds are to

be made true by forcing them through round or oval holes in a steel plate prepared for that purpose. Blocks of wood, with wedge shaped channels are used to retain the bodies in their places whilst the glue is drying. A cutting gauge is employed to divide the glued pieces into proper widths.

This is the whole amount of the patent, and as no claim is appended to the specification, all the modes described must be considered by the patentees as constituting it.

---

11. For an improvement in the *Machine for Weaving Rugs and Carpeting;* William Bacon, Philadelphia, Pennsylvania, April 7.

Without a drawing it would be in vain to attempt to describe a loom of almost any kind; and, in the present instance, although the drawing is well executed, it does not appear to us that the construction and operation of the machine are given with sufficient clearness. The object proposed is to weave rugs and carpeting, not only of the ordinary width, but also without seam, sufficiently large for a room.

The loom, as represented in the drawing, is so constructed that the carpet to be woven stands in an oblique position. Its operation of weaving is thus described. "The chain is put on the yarn beam in the usual way, over the top rail, and through the gears and reeds; from thence extended, by lines, to the cloth beam. The treadles are pressed down, which open the chain, and the filling put in by the needles, one thread at once; the plush is then put in by the proper needles, one for each colour, and worked to any required figure. For this purpose the figure is first divided into small squares, and the colours are then worked so as to correspond with the squares. In this way a carpet of any size, with a border worked in, may be made to fit any room, without seam, and to fit the fire-place and different recesses of the room."

"The roller for the gears is two or three feet long, for one person to work at. There may be any number of rollers, according to the size of the carpet, and number of persons employed."

"*Invention claimed.*—What I claim as my peculiar invention, is, the construction of the before described machine, by which rugs and carpets can be worked to any size and figure, without seam, and to fit any room."

It will thus be seen that the whole machine is claimed, without any reference whatever to any particular arrangement of its parts, although these parts are, in general, similar to such as are found in other looms. To sustain such a claim, the whole construction ought to be new.

---

12. For a machine for *Cutting Mouldings in Wood by Rotary Motion;* Samuel Kennedy, City of New York, April 10.

We are told that "the principle of the rotary moulding cutters, is the forming of mouldings, such as are used by carpenters, frame

makers, and others, by a rotary motion; previous to this the way was always to stick with planes by hand."

The claim is to the wheels used with irons or cutters to form or cut one or more mouldings on one or both sides of the board at the same time; the cutting wheels for the purpose of producing mouldings being considered as entirely original.

A similar machine has been regularly at work in New York ever since December, 1828, at which time a patent for it was granted to Mr. William Woodworth, of that state, who has since established them in other places. An account of this machine will be found at page 199, vol. iii. new series. It has been used principally for the planing, tongueing, and grooving, of flooring boards, but the "cutting into mouldings, either plank, boards, or other material" is mentioned in the title, and is distinctly designated; in the claims made, "the application of cutter wheels" for "cutting mouldings in wood, stone, metal, or other material," are among the terms used. We see nothing in the present machine differing in principle from Mr. Woodworth's, or which, in our estimation, can be called an improvement upon it.

---

13. For a tool called a *Screw Swedge, for Cutting or Forming the Screw Thread in Brass, Iron, Steel, or other Metal;* Richard Whitney, Baltimore, Maryland, April 10.

This patent is taken for the forming of screws on "common screw-bolts, wood screws, and all other purposes for which it is necessary that the screw thread be cut thereon; and an easy method of forging the nuts to be used with said screws after they are thus formed, or made in the old way, with a plate; the aforesaid tool answering all the purposes of common screw plates now in use."

The tools for which this patent is taken are very clearly described, and distinctly represented. There must be a pair of swedges made, one of which may fit into the eye of the anvil, as usual; the upper swedge should have a proper handle and a guide to insure its standing correctly over the lower. In each of these swedges one-half the intended screw is to be sunk just as they are in the dies in screw stocks. The heated metal is to be placed between these, and the screw formed in them by forging. The thread may be angular, or square, as may be desired.

For some purposes this contrivance will undoubtedly answer, but it must be for very common purposes. The stretching, or lengthening of the screw, produced by the common stocks, and especially by the screw plate, which is so injurious to those screws which are intended to work in deep nuts, will be produced in a much greater degree by the proposed plan, excepting in those instances where the length of the screw is not greater than that in the die.

To talk of forging screws of brass in such tools may do for one who has never essayed the working in that metal; we are assured that no worker of brass will violate this part of the patent. We

know that screws might be so cut upon small, cold, brass wire, but we also know that it would be very far from an improvement.

The method prescribed for forging the nuts, is to make them in the usual way, punching the hole sufficiently large to pass over the tap, then to heat them, and forge them on the tap, by striking carefully on their square edges, so as to bring up the thread. Such nuts, if they are to be neatly finished, will require more labour in filing their sides than would have been necessary to cut a good screw with a tap.

---

14. For an improvement in the *Iron Dogs for Saw Mills;* Anson Andrews, Spencer, Tioga county, New York, April 10.

On February 19th, a patent was issued to Mr. Rich, of Condor, Tioga county, bearing the same title. The general form of the dogs is also the same in both cases; in the present instance one of the dogs, or half bails, is made to slide upon a square bar of iron upon the head block, being furnished with eyes for that purpose. There is a regulating screw to set it in its place, and there are graduations upon the iron bar, by which to gauge the thickness of the stuff, and some other appendages, that we do not think it necessary to describe, but that are alluded to in the claim, which is as follows.

"The graduation of the iron bar, upon which the half bail slides, for setting, or gauging the thickness of the lumber; the screw passing through the circular part of the half bail, by which it is moved to and fro; the circular slide; the manner in which the perpendicular bar of iron is attached to the tooth upon the upright part of the bail; the screw passing through the circular slide, and fixed to the said iron bar; the manner in which the teeth are set; and the angle dog."

---

15. For a *Churn;* Isaac F. Waring, Columbia, Hamilton county, Ohio, April 12.

The dasher of a common churn is to be worked up and down by the aid of a crank and a fly wheel. There is no claim. The description is itself a nondescript, and is attended by a corresponding drawing; the *invention*, or *discovery*, is a nonentity, and the whole, therefore, in perfect keeping.

---

16. For an improvement in the *Machine for Thrashing Grain;* James Cooper, Augusta county, Virginia, April 10.

Most of the usual appurtenances of a thrashing machine are found in this, but instead of the hollow segment generally employed, there is an "elastic thrashing cover, or floor," which is formed of slats of wood, placed side by side, and covering the whole length of the cylinder over the beaters; upon these elastic slats springs are made to bear, and between them and the beaters the grain to be thrashed is conducted by the feeding rollers. The claim is to the elastic cover, or floor.

17. For an improvement in *Dogs used in Saw Mills;* Joshua Pierce, Joseph Whitley, and Aaron Whitley, Condor, Tioga county, New York, April 13.

We dare say that this is a very good dog, capable of holding fast, as his teeth appear to be well formed for the purpose. Like No. 14 of the present list, and No. 29 for February last, it is of the Tioga county breed, and is manifestly a mere variety of the species before described, as will be seen by the characteristics that distinguish him in the claim, which is "the *graduated sliding gauge;* its fixture to the dog; its movement by the *screw;* and the *bracing hand.* We also claim the *screw*, and *horizontal movement in* the right hand dog; its fixture to the dog; and the bracing hand as above described."

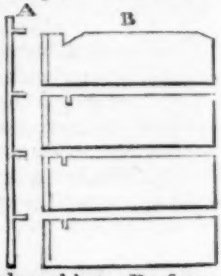
---

18. For a mode of *Locking Drawers of Furniture*, called the "Saving Lock;" Elijah Skinner, Sandwich, Strafford county, New Hampshire, April 13.

What is claimed as new "is the attaching of such slides, staples, pins, &c. to the drawers and furniture, that with one common drawer lock I can lock and unlock any number of drawers in the same piece of furniture, in an easy and cheap manner."

The mode is by causing the lock of one drawer in a tier, or case, to operate in various ways upon a slide extending from the top of the case to the bottom, and furnished with pins or staples to catch upon corresponding parts on each drawer.

It may be that to the patentee this is a novelty, but we can inform him that it has been long known and used. The neatest and most simple mode of effecting it which we have seen, was in two nests of drawers, making part of the stand of a lathe manufactured by Dyerleine and Hoptzaffel, of London, and purchased by us in Philadelphia, in the year 1817. A strip, of which A is a side view, was placed in a groove on the inside of the case, so that it could slide up and down freely at the ends of the drawers; a number of iron pins projected from this strip, so that one might fall into a notch in each drawer. The upper drawer was furnished with a lock; when this drawer was unlocked, and drawn out about an inch, it raised the slide, by the inclination of the notch in the upper drawer, as shown at B, and relieved all the other drawers. This lathe was afterwards sold to Professor Gibson, of Philadelphia, and is probably still in his possession. We have since had the same principle applied to side board, and other drawers.



---

19. For *Revolving Bar Temples*, to be used in weaving; Edward B. Harris and Andrew R. Arnold, Woodstock, Windham county, Connecticut, April 13.

These revolving bar temples are to take hold of the selvage of the

cloth by rows of pins projecting from wheels turning upon pivots. These wheels are fixed in stocks having a horizontal and vertical motion, so as to adapt and fix them in any proper position. In the specification these revolving temples are named as though they were altogether new. Such, however, have been long in use, and secured by patent. In the finer fabrics they were found to leave holes, which, as they did not entirely disappear in the subsequent dressing, was in many cases a serious objection to them. For some improvement upon them, intended to obviate this difficulty, another patent was obtained. We have not now time and opportunity to examine these patents, but have a perfect recollection of the facts which we have stated.

---

20. For an improvement in the *Iron Dogs for a Saw Mill;* Martin Rich, Candor, Tioga county, New York, April 13.

"The dog star rages," at least in Tioga county, New York; these dogs, however, are not affected with hydrophobia, as without abundance of water they would remain in a state of quiescence. Mr. Rich obtained a patent for a dog of an improved breed, in February last, since which two, or rather four of his neighbours, have become his competitors, as we have already noticed; he now comes forward with another dog, which we are informed will retain his hold upon a log of wood, without letting go, after once his teeth have been made to enter it.

In the dogs patented by Mr. Andrews, No. 14, one of the half bails is made to slide endways upon a square iron bar attached to the head block on one side of the kerf, the bar itself turning on pivots in staples driven into the block. In the present patent, each bail is to be so fixed, that the log may be shifted without loosening the dog. The iron bars are cut into notches, or teeth, on one angle, and into these notches springs fall, to hold the bails in their places. A spring attached to one of the bails falls into notches upon a strip or bar of iron fastened to the block, at the back of the dog, to aid in gauging the thickness to be cut. These parts are not very clearly described; the drawing, however, is sufficiently well executed, but it is entirely without written references, and thus fails in an important point. We are not told for what the present patent is taken, although the new and the old are manifestly mixed up together in the description.

---

21. For an improved *Reacting Water Wheel;* George W. Henderson and John E. Cayford, Milburne, Somerset county, Maine, April 14.

We are not of opinion that wheels moved by the reaction of water, on the principle of Barker's mill, will ever be made to produce effects at all equivalent to the quantity of water which they consume. Many patents have been obtained for wheels of this description, usually by persons ignorant of the principle upon which they act,

and therefore incapable of forming a correct judgment of the effect of any new modification of it. We are not aware of any material difference between the wheel now patented, and some of its predecessors. The water is to be delivered through six, or any other number of openings on the periphery of a horizontal wheel, supplied by a vertical shaft, in the usual way; the fluid being conducted to the openings by spiral partitions or floats, so placed as to deliver it in a tangent to the periphery. "What we claim as our improvements," say the patentees, "are setting the floats so as not to project by each other, or, if there are six floats, each float is no longer than one-sixth part of the circumference of the wheel; the floats being thin curved sheets, and fastened to the circumference of the bottom and top." There are some other trifling claims, such as the gudgeon on which the wheel runs; the fastenings used; the applying the reaction wheels to a horizontal shaft, and other things *equally novel.*

---

22. For apparatus for *Grinding and Rubbing down hard Substances;* Barton N. Fyler, Bradford, Orange county, Vermont, April 15.

(See specification, page 235, of the last volume.)

---

23. For a *Machine for Manufacturing Pipes for Aqueducts,* &c. &c.; Thomas B. Armistead, Bloomfield, Ontario county, New York, April 15.

The said machine is merely a common rack and pinion press, to force clay into moulds for forming tubes of earthenware, for the purpose, we are told, of conveying water or gas, making candle moulds, *worms for distillers,* tiles, and all kinds of earthen and stone ware. Although there is no novelty in the machine which is patented, there is much in the idea of making candle moulds and still worms of earthenware, the latter especially; hitherto it has been thought desirable to use metals for this purpose, as being the best conductors of heat, *mais nous avons changé tout cela,* and it is proposed, hereafter, to employ one of the worst conductors, and one, moreover, which may be broken with the utmost facility. As is usual, and proper, when patents are taken for machines which are old, there is nothing claimed as new.

---

24. For a *Washing Machine;* Richardson P. Clarke, Montgomery county, New York, April 16.

The description of this machine occupies six closely written pages, and is accompanied by a well executed drawing. To give an analysis of it, would be merely mill-horse labour, and really we are not fond of going round in the same circle which we have already and repeatedly perambulated. We may be the more readily excused for forming this determination, as, like the machine mentioned in the last article, there is no claim made to any part of it.

25. For an improvement in the process of *Manufacturing Raw or Brown Sugar*, &c. &c.; William A. Archbald, City of New York, April 19.

---

26. For an improvement in the process of *Manufacturing Raw Sugar from Cane Juice;* William A. Archbald, City of New York, April 19.

---

27. For an improvement in *Manufacturing Raw or Brown Sugar*, by improving it after it has been granulated, &c.; William A. Archbald, City of New York, April 19.
(See specifications.)

---

28. For *Manufacturing from Wool, Pantaloons, Stockings, Drawers, Wrappers, Petticoats, Vest Bodies, &c.*, without the process of spinning and weaving; Jesse Foster and James Stoughtenburgh, Greene county, New York, April 20.
(See specification.)

---

29. For an improvement in the mode of *Taking the Figures of Ingrain Carpets from the Cloth;* William Sherwood, Somerworth, Strafford county, New Hampshire, April 20.
(See specification.)

---

30. For a *Churn;* Asael Curtis, Paris, Oneida county, New York, April 20.

The churn is to be an upright square box, with two dashers, each formed of blocks of wood, filling about one-half of the capacity of the box; the handles are to pass through holes in the top, and to be worked by hand, or in any other way which the purchaser of a right may prefer; there is no claim, not even to the making the churn square.

---

31. For an improved *Water Wheel;* Paul Boynton, Oswegatchie, St. Lawrence county, New York, April 20.

This is a propelling wheel, similar in its action to a great number which have been devised to cause the paddles to act vertically in the water, and differing but very little in the arrangement of its parts from several of them. Two wheels, or rather sets of arms, are made to run somewhat eccentrically; connecting pieces from the arms, or periphery, of one, acting upon the buckets, as cranks, to give them the desired position.

This wheel has the merit of being less complex than some of its fellows, but the disadvantages which must attend the multiplication of joints, even in the most simple of these plans, will, we apprehend,

cause this, as it has many others with vertical paddles, to be, on the whole, inferior to the common wheel.

---

32. For an improvement in the *Steam Boiler;* Henry M. Shreve, Louisville, Kentucky, April 21.

This boiler is a cylinder placed vertically, and it is proposed to make it 25 feet long, and forty-five inches in diameter. This we are informed is the size of two which have been constructed and used. A proper furnace is fixed under the boiler, and sixteen flues, each seven inches in diameter, pass through the lower head, and up through the water, to the height of twenty feet; they then pass out through the side of the boiler into a heated air chamber, formed by an iron casing which surrounds the cylinder; the heated air is made to descend between the outside of the boiler, and this iron casing, which is lined with fire clay; the depth of the casing is seven feet 6 inches; two chimnies rise from its lower edge, and conduct off the smoke to a convenient height. The steam pipe, safety valve, and gauge cocks, are placed in the upper end of the boiler, above the termination of the flues.

The patentee says that two such boilers were placed on board the steam boat La Fouche; that the saving in fuel was one-half, and the room occupied on deck not one-fourth, of that usually required. "The risk of the loss of lives and the destruction of a boat, from explosion, is believed to be entirely removed; the upper head of the boiler being the weakest, must give way first, and in case of explosion, the contents will be thrown perpendicularly into the air, where it will be too much cooled before its descent to do any injury, even when passengers are not protected by an upper deck."

The claim is to the passing the flues through the lower end of a boiler, with an immediate escape at any point below the upper end, or with a re-descent along its outer surface when standing in an upright position.

---

33. For an improvement in the *Cast Iron Plough;* Derick Barnard, Washington, Sussex county, Delaware, April 21.

The plough is to be cast in parts in a manner directed in the specification, and by which the patentee considers that many advantages are secured; such as lightness, strength, and several others. This is intended as an improvement upon a plough formerly patented by the same person, and he now thinks "the plough as near perfect as it is possible to construct one upon the present principle." We have not examined the former patent, and are not, in the present, informed what that principle is.

---

34. For an improvement in the *Saw Cotton Gin;* Phineas Gardner, Woodville, Wilkinson county, Mississippi, April 22.

Instead of one gang of circular saws, there are two, one placed

below the other, and working in the intervals between each other, and between openings in the grate-fall, in the usual way. The claim is to "the use of the two saw cylinders, as above described, wherein the saws of each work in the openings of the other, and whereby the cotton is better ginned, with less power than in the usual mode."

We do not see upon what principle the benefit claimed can be produced by this arrangement. The number of saws is the same as in the old machine, and two cylinders are to be driven instead of one, giving the extra friction of a strap and a pair of gudgeons.

---

35. For a *Machine for Washing Clothes;* Hezekiah Thurber, Painted Post, Steuben county, New York, April 22.

A box, rectangular within, and having its sides formed of slats, placed at a distance from each other, is to be turned by a crank, in a water tight trough; into the interior box, the clothes are to be placed, with round balls of wood, to aid in rubbing them; the soap suds is to be poured into the exterior box, or trough. The crank is then to be turned with an irregular motion, and the clothes allowed to fall from side to side until they are cleansed.

The claim is to "the construction and combination of the several parts of the before described machine, and the manner of using it.

There could not well be any thing less definite than this claim, yet we do not perceive how it could have been made more so, as the pigeon holes of the patent office are replete with similar contrivances. "The manner of using it," is, we suppose, the putting the clothes inside, and the turning of a crank; a procedure equally novel with "the construction and combination of the several parts."

---

36. For a "*Self-moving Ink Distributor;* John Prince, City of New York, April 23.

A patent was obtained by Mr. Prince, for an apparatus for the same purpose, on the 3d of December last, and is noticed in the March number of this Journal. There appears to be a strong similarity between the two plans, as in both the spring which gives motion to the inking roller is wound up by the turning of the rounce. We are surprised that no reference whatever is made to the former patent, upon which the present seems to be merely an improvement; in this case the improvements should have been particularly designated, and the present patent taken for them only. Two patents, of different dates, must not occupy the same ground, or a man might extend his right for an indefinite period of time. In the present specification, there is no claim whatever made, the whole apparatus being merely described, and no part particularized as the subject of the patent; in the former, the claim was very distinctly and clearly set forth, as may be seen by reference to page 156 of the last volume.

---

37. For a *Machine for Boring Holes in Rocks;* Israel Overall, Liberty, Smith county, Tennessee, April 23.

A frame is made consisting of a sill, two uprights, and a cap piece,

so as to resemble a frame for a door, or gate; an auger is fitted into a socket in an iron rod, called the driver, this is placed to stand vertically in the middle of the frame, the sill being perforated to allow the shank of the auger to pass through it, and the upper end of the driver being secured in its position by means of a screw and nut, which affix it to a wooden spring, running along under the cap piece of the frame, and extending its whole length; this spring is so attached at its ends to elastic sliding pieces, that it may be lowered by means of slots in the uprights, and follow the auger as it descends; pieces called supports, are attached to the frame to set and keep it upright.

The claim is to "the construction of the whole of the above described machine, except the auger, or bit."

---

38. For a composition of matter for *Making Boots and Shoes of all kinds Impenetrable by Water;* Samuel Eells, 2nd, Middletown, Middlesex county, Connecticut, April 25.

The principal use of the composition designated in the above title, is to render *cloth* water proof, which cloth may be placed between the upper leather and lining, and also between the soles of boots and shoes; we, however, are informed, that "a piece of tarred cloth put between the soles will answer the same purpose."

Without giving the recipe, we may state, that it consists of materials which have been repeatedly used for the same purpose, such as India rubber, turpentine, linseed oil and bees wax, dissolved together, and rendered drying. This composition may be applied either to cloth or to leather; in the latter case it is used in a more diluted state than in the former, and rendered less drying.

---

39. For an improvement in the *Art of Distilling;* Charles F. Fisher, York, York county, Pennsylvania, April 23.

A small doubling still of the capacity of 32 gallons is placed over a common still of from 110 to 120 gallons. The vapour from the beer in the latter, ascends through a tube into the upper still, where there is a contrivance called a separator, which is perforated with small holes for the purpose of distributing the vapour in minute streams, instead of permitting it to rush up in a large volume. The patentee says that his mode of construction is superior to "all others, as it saves fuel and labour, and produces more liquor from the same quantity of grain than any other mode of distilling yet known." He claims "the invention of placing the doubling still immediately over the singling still, and of the separating of the vapour in such a manner as to prevent the liquor that is to be distilled from being thrown apart, or from boiling in large vollies."

---

40. For a surgical *Apparatus for Drawing the Breast,* whenever it becomes necessary to do so, without the suction of the child; Elihu Blake, New York City, April 24.

"My invention consists,

"In having the suction performed by a self-operating elastic bag or bottle of India rubber."

"In devising the means of applying that power to the best advantage, and

"In having a *regulator* to adapt the instrument to any variation in the size or condition of the nipple."

The general description of this instrument is as follows. There is a nipple glass, with a bulb in the ordinary form, excepting that the part to which the mouth is usually applied is omitted, the glass being shortened, and terminating in a neck suitable for tying into that of an elastic bottle. The *regulator* is thus formed, a piece of wire terminates in a button at one end; the wire, forming the shank, is tapped, and has a nut on it to regulate its length. This regulator is of such size as to fit into the mouth of the glass, and is adjustable by the screw, by which the button may be made to stand so near to the end as to prevent the nipple from being drawn too far into the glass. The button is covered with a piece of sponge.

When used, the elastic bag is to be flattened between the hands, and the glass applied; the bag, by its expansion, will then produce the desired effect.

The quotation above made, constitutes the claim, there being no other in the body of the specification; a portion of this claim cannot, we apprehend, be sustained. We have, many years since, applied the India rubber bottle to the nipple glass, in the way, and for the purposes above described, and although it is not recollected where its use was learned, we are convinced that we may not set up any claim to the invention. Our present impression is, that glasses so attached, were known to us as long since as the days of our boyhood.

The regulator we believe to be new, and think it a very good contrivance; much distress is sometimes produced by the ordinary glass, from the effect which the regulator is designed to prevent. Had this been the only claim, we should have esteemed it valid, but joined as it is with others which are doubtful, it partakes of their insecurity.

---

41. For a *Lamp for Burning Lard;* Stephen P. Morehead, Ludlowville, Tompkins county, New York, April 26.

The following is the specification.

"This lamp differs in nothing from the ordinary tin japanned lamp, than there being placed a copper (or some metal containing copper,) wire in the top of it, and near to the tubes containing the wicks, and around which wire the flame plays. This wire being of copper, or of some metal containing copper, is a good conductor of heat, and reaches far down into the body of the lamp. The tubes for the wicks are also of copper, or of some metal containing copper. This lamp is constructed for the purpose of burning lard, instead of oil; the lard being much cheaper, and producing a more agreeable light. The wire and the tubes keep the lard in a liquid state.

STEPHEN P. MOREHEAD.

The foregoing constitutes the specification, and it will be observed

that there is no claim made, the whole being considered as new. The task is not an agreeable one, to inform a person who believes that he has drawn a prize, that a small mistake has been made in his number; we however, have become habituated to this task, and we now again have it to perform. On turning to page 412, vol. iv. of our first series, there will be found a drawing and description of a lamp for burning tallow, and other kinds of concrete fat. This lamp is in the form of the Argand's lamp, and was patented by lord Cochrane. More than twenty years before this we were familiar with the plan and arrangement now proposed. Lamps of this kind were made in Philadelphia with wires and tubes of copper descending precisely as in the present instance, and we believe that the plan was then patented; it, however, is unnecessary to ascertain this fact, as whether patented or not, the lamp equally lacks the essential feature, novelty.

---

42. For an improvement called the "*Concealed Percussion Gun Lock;* Joel Newbury, Poughkeepsie, Dutchess county, New York, April 27.

(Specification in the next number.)

---

43. For a machine for *Glueing Veneers on Columns or Pillars,* to be used in cabinet work; Benjamin Hinkley, Fayette, Kennebeck county, Maine, April 27.

The column which is to be veneered, is to be fixed in a frame, where it is held by screws, but so loosely that it may be turned round, by a cross bar, or crank, affixed to one of its ends. A waxed cloth, somewhat longer and wider than the veneer to be laid, is held in a vertical position, its lower edge being glued into a groove made along the column, and its upper edge fastened to a strip of wood. It is strained tight, by a rope passing from this strip, over a pulley, and acted on by a lever and weight. The veneer is placed against this cloth, its edge resting on the column, glue is then applied, and the column turned, the glueing being continued until the whole is wrapped round. The cloth is so managed as to strain tightly, and close the veneer to the column; it is then left until the glue is sufficiently hardened to take it from the machine, when the cloth is cut off, leaving a strip of it in the groove.

The description of this machine is elaborate, but not clear, the drawing which accompanies it is sufficiently well executed, but is without written references.

---

44. For a *Churn;* Abner Bristol, Hillsdale, Columbia county, New York, April 28.

A crank turns a shaft carrying a cog wheel, which takes into a pinion on a second shaft, on which there is also a fly wheel; a crank on this fly wheel gives motion to a lever, attached at the other end to the dasher of a common churn. This, we are told, is to save labour. For one of its relatives, see No. 15; the family is very large.

45. For a *Machine for Shaping Hammers, Spike Gimlets, and Pod Augers;* Ezra L'Hommedieu, Saybrook, Middlesex county, Connecticut, April 28.

This machine consists of steel rollers mounted in the manner of flatting mill rollers; their surfaces are to be so cut as to form dies for giving the proper shape to the hammers, gimlets, or augers. The claim is to "the application of the above described machine, to shaping the articles aforesaid, as my *discovery.*"

It had been previously *discovered* that nails, screws, spoons, forks, &c. &c. &c. might be formed in the above way. We very much doubt the possibility of sustaining a patent for every individual article which may be made by a well known method, as we cannot in such a case perceive either *invention* or *discovery.* If I want a piece of iron forged into a particular form, and the smith executes it with his hammer, anvil, and tongs, can I claim a patent for these as applied to forging iron into that form?

Among the various machines similar to this, is that of Mr. Davis, noticed vol. v. p. 159, for making nails, bolts, screws, &c. by rollers.

---

46. For a machine for *Cutting Scale Boards, Shingles,* and other articles; Josiah Fairfield, Vassalborough, Kennebeck county, Maine, April 28.

This machine is so much like some others which have been patented, for the same purpose, and which have been long in use, that there is but little doubt of its answering well. This circumstance, it is true, may interfere with its novelty, but not with its utility.

A horizontal wheel is turned by a vertical shaft; cutters, like spoke-shave irons, are placed on the upper side of this wheel, and the block to be cut is held on this side by any suitable contrivance. Nothing claimed.

---

47. For a machine for *Sizing and Napping Hats;* George Henning, Ithaca, Tompkins county, New York, April 28.

Without the drawings, the structure of this machine cannot be very well described, but the following may serve to give a general idea of it. A box is made which is to contain the hats to be sized, or napped. Within this box there is a sheeting, or net work, formed of links of copper, and covered with cloth, upon which the hats are placed. This sheeting can be raised and lowered by means of a lever and pulleys. Pieces, called paddles, and projecting pins, are fixed inside of the box, so that when the sheeting is drawn up by means of the lever, a strong pressure may be made upon the hats. The box, when used, is to be placed over a boiler, or kettle, of boiling water.

The claim is to "the whole of the above described machine, when applied for *sizing* or *planking* hats; and the bed of copper sheeting, or chains, with paddles and pins, when applied in *napping* hats."

We are informed that the above machine is highly approved, and bids fair to be extensively used, as it operates well and saves much labour.

By turning to the last volume, page 31, it will be seen that Mr. D. Baldwin, of Ithaca, New York, obtained a patent for a machine perfectly similar in principle, dated in October last. The likeness is so strong, that one is certainly the parent of the other.

---

48. For an improvement in the *Art of Making Glue;* Peter Cooper, City of New York, April 29.
(Specification in the next number.)

---

49. For an improvement in the *Mode of Mortising*, as in window sashes, doors, cabinet furniture, and the like; Abner Foster, Machinist, Phillipston, Worcester county, Massachusetts, April 29.

The above named machine is very clearly described, and very perfectly represented in the drawing; in its general structure it resembles a machine patented by Mr. John M'Clintic, Chambersburg, Pennsylvania, October 8th, 1827. In that machine, the chisels were brought down, and raised, by means of a lever moved by hand; in the present, two treadles are employed, one operating on a chisel to the right, and the other on a chisel to the left, to finish each end of the mortise; the chisels are elevated by means of spring poles. The only parts claimed are "the springs, and the treadles, and their application to the purposes of mortising."

Specifications of American Patents.

Specification of a patent for an improved mode of taking the Figures of Ingrain Carpets from the Cloth. Granted to William Sherwood, *Somersworth, Strafford county, New Hampshire, April 20th,* 1830.

This improvement will best appear by comparing it with the old methods. *First.* Figures have been taken from the cloth by the tedious operation of counting the threads. *Second.* They have been taken by copying the figure upon design paper, and then placing the paper against a reed, the splits of which correspond with the design, a simple having been previously drawn through each split. The figure is then picked up by the simples, where the paper is painted. In my improvement no reed is used, but a loop is made in the end of each simple, and the cloth being wound upon a roller, or beam, the filling is taken out of the centre of the figure. The changes of warp which make the ground of the carpet, are drawn through the loops, and wound upon another beam, which brings the cloth in a horizontal position, and the threads of warp which make the figure, are cut off close to the cloth. A wire is then run into the place of the centre thread of filling, which makes the figure, and when shoved back against the simples it separates the two parts required. The centre lash, or change of the filling, is then drawn out, and the next

lash is taken in the same way, and so on, until the figure is completed.

Instead of drawing the threads of warp, which make the ground, through the simples, as above described, those threads which make the figure, may be taken for that purpose; in which case the changes must be made by the filling of which the ground is composed, or a wire put in its place.

What I claim as my specific invention, is the connecting the threads to the simple. WILLIAM SHERWOOD.

Specification of a patent for a process or method of purifying, tempering, and preparing the Juice of Cane, cultivated and grown in the United States, and rendering it better fit to be converted into Sugar than has hitherto been done. Granted to AUGUSTUS ARCHBALD, *Sugar Refiner, of the City of New York, April* 19, 1830.

THIS discovery, application, or invention, consists, *first*, in neutralizing the juice, that is to say, rendering it perfectly free from acidity, without allowing lime, or any other alkali, that may be used, to predominate. *Secondly*, in precipitating the impurities, and thereby admitting of its being converted into sugar, with little or no skimming. *Thirdly*, in imparting to the juice the colour, or hue, that may be desirable for brown sugar.

For carrying into effect this my said improvement, I do operate as follows, that is to say, I do collect in one or more wooden, or other vessels, the juice running from the mill; the aforesaid vessel, or vessels, being arranged, and fitted in the interior with a copper pipe, circulating round the bottom, which may or may not be perforated with holes, as may be deemed most convenient, and so fitted with cocks, and connected with the steam generator, as to allow of the steam being let on and turned off at pleasure; the mode of arranging which pipe, will be understood by any engineer, or coppersmith. The receivers being sufficiently full, I do proceed to purify the juice, and prepare it for being converted into sugar in the manner following. I do mix well with the juice a certain portion of the mixture composed of lime and alum, called *finings*. I do apply the aforesaid mixture in the proportion of two pounds, or thereabouts, to every hundred gallons of juice, the mixture being well stirred with the juice. I do throw in, and stir well with the juice, small portions of good well slacked lime, made perfectly fine before applying it, or any other alkali, (preferring lime, as being most economical) and I do continue to add the same, until the test paper, or any other test that may be used to show the presence of acid, no longer changes colour. I do then examine the juice with the test paper, or other test showing the presence of lime, to ascertain whether I have given an excess of lime, or other alkali, in which case I do let in more fresh juice, in order to neutralize the excess of lime. Having by this first operation ascertained exactly the

quantity of lime requisite to temper or neutralize a given quantity of juice, in all subsequent operations, I do throw in at once the full proportion of lime, and mix it well with the juice, before heating it. The juice being thus perfectly freed from acidity, I do turn on the steam, and heat it nearly to the boiling point, or make it so hot that the hand cannot be dipped into it without the danger of scalding. I do then stop the steam, and immediately throw into the juice, and mix well with it, a further portion of the aforesaid mixture, made thin with water, which portion will be determined by observing in a tumbler, or other glass vessel, the rapidity with which the impurities of the juice precipitate; a sufficiency being applied, the juice is allowed to remain till the impurities settle, when the clear liquor is drawn into the evaporators, to be converted into sirop, or sugar, and the residue, or sediment, into another receiver, where it is mixed with a small quantity of hot water, and a small portion of lime, and allowed to settle, when the clear part is drawn off, and converted into sugar with the rest of the juice. Should it be desirable to impart a lighter colour to the aforesaid juice, I do increase the proportion of the aforesaid mixture, after stopping the steam, to allow the juice to settle as aforesaid, and I do declare that it is not indispensable to use the aforesaid finings, as the cane juice can be purified, though but very partially, with lime, or any other alkali alone, but the sugar therefrom has a tendency to turn gray, a colour always fatal to it in the grocer's market; besides, the impurities precipitate with difficulty, and the juice is dark.

I have discovered that finings applied to the cane juice as aforesaid, purifies the juice much more perfectly, hastens very considerably the precipitation of the impurities, and imparts to it, which is communicated to the sugar, that beautiful straw orange colour so much admired and desired in brown sugar; and, what is of no less importance, renders the molasses drained from the sugar made from juice that had been treated with it, much more pure and fit to be converted into sugar than it would otherwise be. It has been ascertained that by purifying the cane juice, and precipitating the impurities by the method aforesaid, a very large increase of sugar can be obtained, from a given quantity of cane, beyond what can be extracted when treated by the ordinary process of tempering and skimming.

The difference between my method of treating and preparing cane juice, and that generally used, consists in my precipitating the impurities thereof, whereas the impurities of the juice have hitherto been got rid of, and that very imperfectly, by skimming. My mode of tempering differs also materially from that usually followed. By my method the exact quantity of lime required by the juice, to correct the acidity therein contained, is applied with ease and precision, and the most ordinary negro, or even a boy, may in a few hours be taught to temper with the greatest correctness; whereas by the method of tempering generally pursued, it requires years of experience, and the most intelligent person; and even then it cannot be done with any kind of certainty, as sometimes too much lime is

given, which makes the sugar dark, and at others too little, in which case it granulates badly, consequently a large quantity of molasses is produced, and it drains with great difficulty. And with regard to the aforesaid mixture of lime and alum, or saturation of lime and alum, called finings, although I do not claim to have invented that compound, it having been long known; having discovered the important and valuable effects produced by it upon cane juice, I do mean to apply for letters patent to entitle me to the exclusive right to the application of the same to cane juice, for the purposes for which I employ it.

I will now proceed to state the method of preparing the aforesaid mixture called finings, which is as follows: a quantity of alum is melted either in a wooden or copper vessel, with its own weight of water, or thereabouts. A quantity of good well slacked lime, mixed with water sufficiently thin to allow the gross particles, or the lime that has not dissolved, to subside, leaving a kind of milk of lime, or very strong lime and water; this lime is then added to the alum, till the test paper showing acidity, changes colour no longer.

The test paper showing the presence of lime is then tried, to ascertain that lime does not predominate, the mixture being made perfectly neuter is then thrown upon a strainer, and allowed to drain off the water, when it is fit for use.

My invention, or improvement, upon which I claim in these my letters patent, an exclusive privilege, consists in this, my process, or method, herein specified, of purifying and preparing the juice of the cane grown or cultivated in the United States, intended to be converted into sirop, or sugar. W. A. ARCHBALD.

Specification of a patent for an improvement in the making or manufacturing of Raw or Brown Sugar, from the Cane Juice, or from the sirop made therefrom. Granted to WM. A. ARCHBALD, *Sugar Refiner, of the City of New York, April* 19, 1830.

THIS improvement consists in concentrating, or converting the said cane juice into sirop, or sugar, in wooden vessels; which wooden vessels may be made of any convenient shape or size; in preference made of well seasoned white pine, fitted up and arranged in the interior with a copper pipe of a dimension suited to the size of the vessel which may be deemed convenient for the operation; or with a copper or other metallic vessel in the form of a globe, or in any other form calculated to receive and retain steam, and impart the heat thereof to the juice, or liquid, by which it is enveloped. But I do use in preference wooden vessels in the form of tubs, or tanks, of a round shape, hooped with iron, fitted in the interior with one or more rows of copper pipe placed horizontally, either lying close together, or at a small distance from each other, which pipe I do bend in a circular form so as to occupy and fill up the whole of the interior surface of the bottom of the tub, except a small space in the

centre, in which space I do fix a valve with a rod attached thereto, for the purpose of drawing off, or allowing the liquid to escape. This pipe is connected with the steam generator, and fitted with cocks to allow the steam being let on to boil the juice or liquid, and stopt at pleasure; which any engineer, or coppersmith, can arrange.

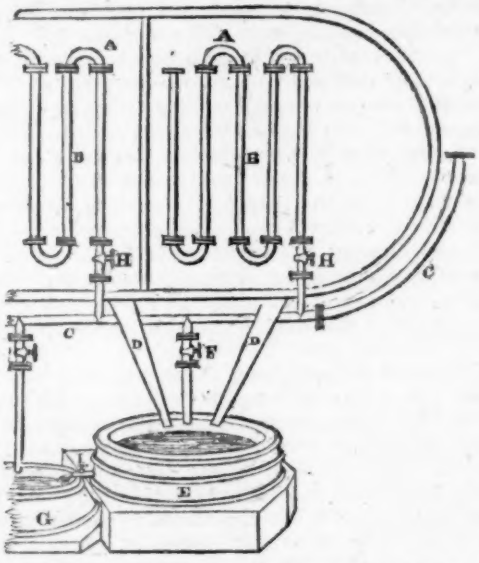
Now for the purpose of boiling or concentrating the cane juice into sirop, or sugar, I do use three or more of these wooden vessels, or tubs, placed one above the other, on wooden frames, so as to admit of the liquid being conveniently and freely drawn by a cock, or valve, into the lower one, which I do use as a concentrator, the others operating as evaporators. And I do by preference arrange the pipes of the aforesaid concentrator, so that both rows are close together, lying upon the bottom of the tub; while those of the evaporators are raised six or eight inches above the lower one, in order more equally to distribute the heat of the steam in the liquid; the lower end of this pipe I do pass through the bottom or side of the tub, so fixed as to prevent leakage at the hole through which it passes, at the outer end of which pipe, in each tub, I do fix a cock to allow the condensed steam to escape; and I do declare that in order to boil with economy and advantage, I do make use of the same steam that is employed to work the engine, that is to say, I do use steam generated by the same fire that is employed to produce steam for the engine, although steam generated in any way would answer. The aforesaid tubs may be arranged and placed in any way most convenient for operating; and the steam should be of a high temperature, such as is produced from steam of 40 or 50 lbs. to the inch, or upwards; the higher the temperature the more rapid the operation, and the better the effect upon the sugar.

In order to supply the tubs with juice, I do conduct it from the receiver by means of a wooden or other spout; the juice being converted into sugar, is drawn off into a cooler, and then transferred to moulds or hogsheads.

I now proceed to state the advantages to be derived from boiling the cane juice in wooden vessels, instead of, as is now done, in those of metal; and these advantages are, *first*, the cheapness with which they can be made, and the ease and economy with which they can be arranged and set. *Secondly*, their great superiority over metallic vessels in retaining heat, causing a considerable saving of fuel, and the rapidity of boiling resulting from wood being a nonconductor of heat, consequently not allowing any portion of the heat imparted to the liquid from the steam to escape, but confining the whole of such heat to the liquid. *Thirdly*, the absolute impossibility of burning the sugar, which by the ordinary mode of boiling almost invariably occurs, from the heat of the vessel. *Fourthly*, their seldom or never wanting to be renewed, and hardly ever needing to be cleaned, whereas the vessels now used, not only require to be frequently cleaned, at great trouble and loss of time, but often crack, or break, by which the planter is retarded in his operations, and suffers great loss.

I claim under these my letters patent, an exclusive privilege in

my improvement, which consists in boiling cane juice into sirop, or sugar, in wooden vessels. WM. A. ARCHBALD.



DESCRIPTION OF THE APPARATUS REFERRED TO IN THE FOREGOING SPECIFICATION.

A, A, receivers for the juice from the mill, serving as clarifyers.

B, B, copper pipe for heating the juice.

C, general steam conductor, leading from the steam boiler.

D, D, spouts to lead the juice from the clarifyer to the evaporators.

E, evaporator.

F, cock connected with the worm in one of the evaporators.

G, concentrator.

H, H, cocks connected with the pipe of the clarifyers.

I, cock to draw the juice from the evaporator to the concentrator. The evaporators may be multiplied to any convenient number.

Note. The pipe in the clarifyers may be perforated with small holes, but it would be preferable to lead the condensed water off by a cock, instead of perforating the pipe.

Abstract of a specification of a patent for an improvement in the making or manufacturing of what is usually termed Raw Brown Sugar, from the juice of the cane grown or cultivated in the United States. Granted to WM. A. ARCHBALD, *Sugar Refiner, City of New York, April* 19, 1830.

THE improvement in the manufacture of sugar, consists in a mode of cleansing it of its molasses, after granulation, and imparting to it

a colour desirable for brown sugar, which is to be effected in the following way.

The sugar being sufficiently boiled, and cooled to the proper degree of temperature, is transferred into moulds, instead of into hogsheads, each mould containing from eighty to a hundred pounds. After it has become sufficiently hard, the moulds are taken into a room of a suitable temperature, generally a little above summer heat, the stoppers are then withdrawn, the sugar pierced, and placed to drain; at the expiration of about twenty-four hours, the cleansing process is commenced, in the following manner; the crust of the sugar is broken, and all the hard part, known by the name of *foot*, dug out; a certain quantity of cane juice, previously boiled to a proper density, and allowed to become perfectly cold, is then poured upon each mould, about a gallon is usually employed; this operation is three times repeated, at intervals of about twenty-four hours. The density given to the sirop is about thirty-two degrees of the *pese sirop*, of Beaumé; great precision is not required in this particular, and it should vary according as the sugar may have been high or low boiled. If at the expiration of twelve hours the sirop has not descended into the sugar, the surface should be again broken, and the loose sugar stirred up with the sirop; a small quantity of milk-warm water may also be added, mixing and combining it well with the sirop; the sugar also should be again pierced. At the end of three or four days after the last application of the sirop, one or two of the moulds should be emptied, to ascertain whether the sugar is sufficiently cleansed; if not, the operation must be again repeated upon all the sugar of the same day's boiling. It is then to be left to dry in the moulds until fit for the market.

The sirop which has been employed as above, may afterwards be converted into sugar, either by mixing it with the cane juice, or with the molasses drained from the sugar upon which it has operated, and then converting the mixture into sugar, or it may be converted into sugar alone, as may be found most convenient. In either case it may, in its turn, be subjected to the cleansing process.

The difference in this process as above described, and such as have been formerly used, is thus stated. The process which the patentee has applied to raw sugar, has hitherto been confined to refined sugar. The refiners invariably employ granulated, and generally white sugar to compose the sirop, which they clarify by the use of expensive materials, and at considerable labour. Great loss is consequent upon the employment of sugar in this way, sometimes to the amount of fifty per cent., as it is diminished in quantity and deteriorated in quality. In the present process, instead of expensive granulated sugar, simple sirop, which has never been made into sugar, is used, and suffers no diminution, or deterioration. There is a marked difference, therefore, in the two processes, first in the employment of sirop which is only in progress towards the formation of sugar, instead of sugar actually formed; and also in its application to brown, instead of to refined sugar. This consequently is deemed a new application of the process, producing new and valuable results.

The negroes in some of the colonies have been in the practice of pouring what they term *liquor*, upon the sugar in hogsheads, but it is notoriously a bad practice, injuring the article, and causing it to be rejected by the grocer. This liquor is, generally, a thin hot sirop, often poured on in a boiling state, which melts the grain of the sugar, descends but a few inches below the surface, concretes, and forms a dark, solid mass, producing great loss, and should it even drain through, it mixes with the molasses, and is sold as such. The present process varies materially from the foregoing, and depends for its success upon this circumstance; a thick sirop, in a cold state, is applied to the sugar in moulds, it being impossible to operate to the same advantage in hogsheads.

"My improvement consists in cleansing, or improving, what is generally termed raw brown sugar, made from the juice of the cane cultivated in the United States, by employing for that purpose cold sirop, made from cane juice, of a density suited to the sugar to which it is applied."

The first specification in this series explains the method of purifying and preparing the cane juice; and the second relates to the wooden vessels, &c. employed for concentrating it.

Remarks by the Editor.—The last of the three preceding specifications we have condensed into less than half the compass which it originally occupied, and as we have done this without omitting any thing necessary to a full exposition of the views of the patentee, we apprehend that our readers will not complain.

The culture of the cane, and the manufacture of sugar, have become objects of great national importance, and are rapidly extending. The cane has been planted as far north as South Carolina, and that with considerable success. The whole business, however, is a new one in the United States, and we have determined, therefore, to publish such information upon the subject as may appear to us likely to do good; and particularly those processes for which patents have been obtained either at home or abroad. In carrying this intention into effect, we shall be careful not to devote an undue portion of our Journal to this particular inquiry, to the exclusion of that variety which is an essential feature of such a work.

In our selection of English patents, we are frequently governed by their similarity to such as are obtained here, although we have rarely thought it adviseable, or necessary, to particularize the instances, but have left them to speak for themselves.

Specification of a patent for manufacturing from Wool, without the process of spinning and weaving, Pantaloons, Stockings, Drawers, Wrappers, Petticoats, Vest Bodies, &c. Granted to JESSE FOSTER *and* JAMES STOUTENBURGH, *Green county, New York, April* 20, 1830.

SPECIFICATION of the method of making the various articles above mentioned.

1st. A carding machine without the roller, and the doffer covered with cards so as to bring the wool from the machine in a continued web.

2nd. The web is thrown on an apron of leather, or other material, which revolves round a platform, or table, with rollers to each end.

3d. From this apron the web is wound upon a pattern of the articles to be constructed, diagonally, so as to cross the wool in every direction, until a proper thickness of the web is obtained, and is then taken from the pattern, and hardened, either by steam, or heat, and is then fulled or planked, to a suitable consistence, and dressed and finished, with or without colouring.

4th. Patterns of the articles may be made of wood, and suitably adapted to each garment. Pantaloons are made in two entire legs and upper parts, requiring a single seam to connect them and form the article. Stockings, petticoats, are made entire, and other articles according to pattern.

JESSE FOSTER.
JAMES STOUTENBURGH.

Remarks by the Editor.—The foregoing specification seems to proceed upon the idea that the thing proposed to be done is perfectly new in every particular, yet there is not any thing in it different from the mode in which hat bodies have been set up. There is, it is true, some difficulty in knowing what is intended to be patented, yet if we take the words of the specification itself, it is for the *method* of making the various articles mentioned; in this case there must be some novelty in the machinery, upon which to found a claim; there, however, is no drawing accompanying the description, which there must have been, had the patent been taken for any thing admitting of drawings. By the term method, therefore, we must not understand the employment of a machine. Is the method felting? this is not only old in itself, but the mode of laying the wool upon a piece serving as a pattern is so also. There remains, we think, nothing to claim but the making of the particular articles enumerated, by a method before known and used, in doing which there would not appear to be much either of *invention* or *discovery*.

Our readers are aware that some half dozen patents have been recently obtained for making cloth by felting; time enough has elapsed to have brought some of it into our markets, had the process been effectual; we are very apprehensive that the circumstances which caused similar attempts to fail both in France and England about forty years ago, and which have defeated many successive trials both in Europe and this country at various subsequent periods, will still render it necessary to twist the fibres of wool, and pass them through the loom, in order to the production of good cloth. So far as we know, all the fabrics which have been made in imitation of cloth, by felting, have been sleezy and weak, or thick and harsh.

Specification of a patent for a Self-operating Temple. Granted to Ephraim R. Otis, *Lyme, New London county, Connecticut, April 2, 1830.*

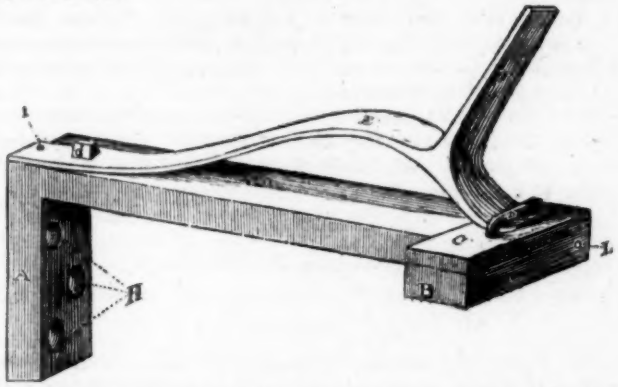
Be it known that I, Ephraim R. Otis, of Lyme, in the county of New London, and State of Connecticut, have invented a new and useful self-operating temple, and that the following is a full and exact description of the construction and operation of the said machine as invented by me.

A, in the drawing hereto annexed, represents the standing part of the temple, which is made of iron, and is attached to the breast beam of the loom (two temples to each loom.)

B, represents the lower or under jaw of the temple, which, together with the standing part, is of one piece of iron.

C, represents the upper jaw of the temple, which is grooved on the under side like a common float file, and is connected at one end, L, by a hinge; the cloth passes between the jaws.

D, represents a staple attached to the upper jaw under which the spring, E, plays.



E, represents a spring of steel, attached at one end to the standing post, by an iron pivot, or pin, marked I, and a screw marked G, and rests on the jaw C, and passes through the staple D.

F, represents a piece of iron about two inches long, connected with the spring E, by which the temple is made to open, shut, and grasp: the part F, being operated upon by an iron knob, or wood screw, placed in the top part of the lathe of the loom, projecting from ¼ to 1 inch, and striking against the projecting part F, of the spring E, which opens the jaw and permits the cloth to pass, and again closes.

G, represents a square screw, made to turn with a wrench, or driven, to tighten or loosen the spring, as may be required.

I, represents an iron pivot which attaches the spring to the standing part.

H, represents three holes in the standing part countersunk for screws to attach the standing part to the breast beam of the loom.

L, a screw passing through the hinge, which connects the upper jaw C, with the lower and immoveable part. E. R. OTIS.

Remarks by the Editor.—On the 19th March, 1827, a patent was obtained by Alfred Jenks and Jesse Clewell, of Holmsburg, near Philadelphia, for a spring temple, which in its general construction and operation bears so strong a resemblance to the one above described, as to lead to the conclusion that they are merely different forms of the same thing. In the specification of Jenks and Clewell, each temple is stated to consist of two plates, or pieces, fastened together by means of rivets, or of screws, and of a lever by means of which the jaws formed on one end of the plates may be separated from each other. The lower plate is to be fixed to the breast beam of the loom by means of screws, for which purpose it is perforated with holes, or rather with slots, by means of which it may readily be adjusted to its place.

"A pair of these temples are fastened to the breast beam, at such distance apart that the cloth may pass within their inner edges, whilst their lateral jaws will embrace the selvage." "From the lower part of the lay, adjusting screws project forward, so that at every beat they touch the levers, and open the jaws of the temples, which again close as the lay recedes."

Some difference in arrangement might be expected where two persons had conceived the same idea, whilst each had devised his own mode of carrying it into effect; *more* than this will not be found in the present case.

ENGLISH PATENTS.

To JOSHUA BATES, *Merchant, for a new process or method of Whitening Sugars.* Dated August 1, 1829.

IN describing the benefits to be derived from this invention, the patentee, to render them more clear, describes that part of the preparation of loaf sugars termed "claying," in which he states that the raw sugar after having undergone the operations of clarifying, boiling down, and graining, is poured whilst yet warm and in a liquid state into unglazed earthenware pots, of the form of an inverted cone, having an aperture at the taper end; this, however, is stopped up whilst the sugar remains liquid, and the latter is stirred up with a stick several times whilst being poured into the pots, in order to prevent its sticking to the sides, and consequently, to facilitate its expulsion when required. The sugar when cool is no longer fluid, but an aggregate of crystallized grains, the spaces between them being filled up with a brown sirop, which, owing to the porosity and consequent capillary attraction of the former, would never drip out unless by the action of water. To expel this sirop, therefore, the process of claying is resorted to, which is effected by mixing up a

quantity of pipe-clay to the consistency of batter, and placing it on the surface of the sugar about one inch in thickness; the consequence of this is, that the water, extricating itself by degrees from the clay, filters gradually through the sugar, and finally through the aperture in the pot, carrying away the sirop which mixes with it on its passage. This operation is again repeated, and sometimes a third time, the clay being removed and a fresh mixture applied on each occasion; the sides of the pot being gently tapped, the loaf comes out, and is found whitened, with the exception of the point, which frequently retains a rather inferior colour.

To this, which is the ordinary mode of operation, there are several objections, which the patentee states his invention will obviate. The quality of the sugar is impaired by the irregularity with which the water passes through it, as the liquid must necessarily percolate more quickly when the batter is first placed on, than towards the end of the different operations, when the clay becomes nearly dry. This latter after its first use is again mixed up for future occasions, and, as appears by the patentee's statement, it imbibes a portion of the sugar, from its continual contact with it, and when exposed to the heat of a sugar house, frequently becomes sour and imparts a bad flavour to the sugar to which it is next applied.

To remedy these defects, he constructs a small circular vessel or saucer, of unglazed earthenware, of that description of which wine coolers are generally manufactured, which is made so as to fit into the larger end of the sugar pots, with an interval of about half an inch round its sides. This being placed on the sugar, in the same situation where the clay batter is usually employed, is filled with water, which, percolating through it gradually and in a minute state of division, may be caused to continue filtering through the sugar with unvaried regularity, until the whole loaf, including also the point, be entirely divested of sirop. Mr. Bates does not confine himself to the substance mentioned for forming the filters, but states, that they may be constructed either of hair sieves, in which a quantity of sand has been placed, of filtering stones, or of any material through which liquids will pass gradually and minutely divided.

The above is the nature of the improvements as relating to the whitening of loaf sugars; the patentee in continuation observes, that in the whitening of raw or muscovado sugars by the process of claying, it is found impossible from the partial adhesion of the grains to each other, to cause by pressure an equal distribution of the water. To remedy this defect and the consequences arising from it, he employs a large circular pan, the bottom of which is fitted with an indefinite number of pots, of the same form as those employed for the loaves, and like them furnished with an aperture; into these the raw sugars are pressed, and a vessel similar to the first described filter, only varying in size, is placed over the pan and filled with water. This plan, he observes, has been found to whiten sugars more effectually than the ordinary method: and, as he claims as his invention, the employing a series of moulds, or inverted cones, for

the raw sugar, he states, that the process of claying may be also used in conjunction with them, in lieu of his filter, as described.

[*Repertory Pat. Inven.*

To MOSES POOLE, *Gentleman, for certain improvements in the apparatus for Raising and Generating Steam and currents of air, and for the application thereof to Locomotive Engines and other purposes. Communicated by a Foreigner.* Dated July 8, 1829.

THE first part of these improvements consists in the formation of the boiler of a steam engine; this is constructed of a series of tubes placed so as to form a sort of square cage work, surrounded by a casing of iron, into which the fuel is placed, and having an opening at the top for the chimney. The tubes are placed in a horizontal position, and each is screwed into an iron casting, being made steam tight by bringing over a nut at the opposite side, with a packing of asbestos or fire-lute interposed. The size of these tubes is to be regulated according to the power required; but those represented in the drawing of the specification are on a scale of three feet in length, with a bore of one inch: they are shown as attached to a locomotive carriage, to which the patentee states them to be eminently adapted.

The pipes communicate with one another throughout the whole series, and to the extremities of the first and last, or, for better explanation, to the two ends of the coil of pipes, are affixed two vessels or receptacles of steam, which Mr. Poole terms the "*separators;*" where any water which may be forced into them along with the steam, will separate itself by its own gravity, and will be then re-circulated through the tubes by the force pump above mentioned. When it is required to clean them, this can be done by a rod furnished with a barb, similar to that employed in cleaning guns, being introduced into the pipes by withdrawing the nut; water is then forced through them by the pump, and all sediment being loosened is carried off.

The next improvement is the causing the steam to enter below the piston at the bottom of the cylinder, (which is placed horizontally) by which means, the patentee states, any water that may accidentally flow into it will be forced out; this he asserts would *not* be the case if caused to enter above the piston, as in ordinary engines. In adapting this engine to a locomotive carriage, rotary motion is imparted to the hinder wheels by means of cranks, and the parallel motion of the pistons is regulated by a wheel running on iron rods.

To generate the currents of air as expressed in the title, a tube is affixed to the waste pipe, from the former of which branch out three or more very small tubes; these are carried to the chimney, where it is stated they will be found of peculiar advantage, particularly in carriages where the flues are necessarily short; the effect they will produce being a continued draft through the fuel, arising from the steam in passing through the minute apertures of the small tubes, causing by its velocity a partial vacuum in the chimney, which can

only be filled up by air passing through the fuel, every other aperture being closed. There is also described, a method of stopping the carriage, or retarding its progress, by means of a lever attached to the perch, between the hinder wheels. This lever works like a hinge, in an iron sledge or drag, which is attached to a chain that extends under the whole length of the carriage, and passes round a small windlass, that is worked by a handle passing upwards to the seat of the driver. When it is required to stop the coach, the chain is wound round the windlass, and in thus pulling forward the drag and lever, the latter, being made somewhat longer than the radii of the wheels, lifts the hinder ones from the ground, which continue their rotary motion without propelling the carriage; the engine consequently continuing to work, the circulation of water through the boiler is not prevented. [*Ib.*

FRANKLIN INSTITUTE.

Monthly Meeting.

The stated monthly meeting of the Institute was held at their Hall on Thursday evening, May 27, 1830.

Professor A. D. Bache was appointed chairman.

The minutes of the last meeting were read and approved.

The following donations were presented to the Institute, viz.

Dobson's Encyclopedia, 18 *vols.* presented by Charles J. Ingersoll, Esq.

Scott's Life of Napoleon, 3 *vols.* presented by Mr. S. V. Merrick.

Register of Arts and Sciences, 1*st vol.* presented by Mr. W. H. Keating.

Speeches on the Jew Bill, in the House of Delegates of Maryland.

The American Biographical Dictionary.

Nugent's Dictionary of the French and English Languages.

A Catalogue of the Loganian Library, with an account of the Institution, presented by Mr. Edward G. Dorsey.

Description of the Jackson Bridge, with directions to the Builders of Wooden or Frame Bridges.

Notice d'Instruments, d'Optic, de Mathématique, et de Physique, presented by Isaac Hays, M. D.

A general collection of Maps, Charts, Views, &c.

A series of the Freeman's Journal, from 1*st of January to* 31*st December*, 1821, *bound.*

The American Museum, 4 *vols.*

The Analytic Magazine, 1 *vol.* presented by [illegible]

Washington's Letters to Arthur Young.

Catechism on Education, presented by Mr. Adam Ramage.

Message from the Governor, accompanied with the report of the canal commissioners, read in the House of Representatives, (Pennsylvania) December 13, 1828.

The Report of the Board of Canal Commissioners to the Senate of Pennsylvania, December 18, 1829.

The Report of the Committee on Roads and Canals, to Congress, on the Chesapeake and Ohio Canal, January 2, 1828.

The Fifth and Sixth General Report of the President and Directors of the Chesapeake and Delaware Canal.

The Annual Report of the President and Managers of the Union Canal Company of Pennsylvania, November 20, 1827.

Letter and document in relation to the dissolution of the engagement of L. Baldwin with the Union Canal Company.

The proceedings of the Citizens of Baltimore respecting improving the intercourse between that city and the western states, presented by Mr. George Merrick.

The corresponding secretary laid on the table the following works, received in exchange for the Journal of the Institute, viz.

London Journal of Arts and Sciences, for April, 1830.

The Mechanics' Magazine, for March.

The Register of Arts and Journal of Patent Inventions, for April.

The Repertory of Patent Inventions, for April.

Gill's Technological and Microscopic Repository, for April.

The Quarterly Journal of Science, Literature and Arts, No. 13, new series.

The American Quarterly Review, for April.

Annales de Ciencias, Agricultura, Commercio y Artes, vols. 1st and 2nd.

The American Journal of Education, for May.

The committee appointed to fit up the library and reading room, reported that they have collected about $400 in voluntary subscriptions from the members, and were progressing in the object of their appointment.

The committee on inventions presented their report on William Woodworth's machine for planing, tongueing, and grooving boards, and also on Whiting's improved saw set, which were severally read and accepted.

The committee appointed to try the experiments on water wheels, reported that they were daily progressing in the duties assigned to them; they also communicated the following letter, addressed to their chairman, and received a few days since.

Boston, May 6, 1830.

Sir,—The laudable measures adopted by the Franklin Institute, for ascertaining "the value of water as a moving power, and the relative effects produced by it on water wheels of different constructions," having been made known to the Directors of the New England Society for the Promotion of Manufactures and the Mechanic Arts, the undersigned were appointed a committee, to make inquiry, as to the expediency of affording aid in the prosecution of such experiments as may be necessary to establish the principles upon which that power may be calculated, and most advantageously applied.

From information derived from the various communications published in the Journal of the Franklin Institute on this subject, and that obtained by one of the committee, who has recently visited

Philadelphia, and examined the apparatus used in the experiments, we are happy to assure you of our entire confidence in the abilities of the gentlemen charged with this highly interesting and important inquiry, and of our satisfaction as to the manner in which it is prosecuted. The results cannot fail to be of great public utility, and to do honour to the institution which caused them to be attained. We, therefore, are authorized by the New England Society for the Promotion of Manufactures and the Mechanic Arts, to subscribe three hundred dollars to the fund required for conducting the experiments, which have been commenced under such favourable auspices, and enclose, most cheerfully, a draft for that amount.

With great respect, we have the honour to be

Your most obedient servants,

P. T. Jackson, } *Committee New England*
H. S. Dearborn, } *Society P. M. and M. A.*

Samuel V. Merrick, Esq. *Chair. Com. Experiments, &c. &c. &c. of the Franklin Institute.*

The subject of accidents occasioned by explosions of boilers in steam boats, was introduced by a member, which gave rise to a very animated and interesting discussion, in the course of which the different causes of these accidents were pointed out, and various means suggested for guarding against their consequences and occurrence.

Alexander Dallas Bache, *Chairman.*

Isaac B. Garrigues, *Recording Secretary.*

BOARD OF MANAGERS.

Proceedings relating to the Explosion of Steam Boilers.

At a meeting of the Board of Managers of the Franklin Institute of the State of Pennsylvania, for the Promotion of the Mechanic Arts, held at their Hall on Thursday, the 13th of May, 1830, the following preamble and resolution were passed, viz:—

Whereas, the object for which the Franklin Institute was established, was the promotion of the success of the mechanic arts by all the means within their power, and whereas numerous accidents have occurred, of late, in steam boats, the effect of which is to impair the confidence of the public in the merits of an invention which has shed vast honour on the American name, and which has essentially contributed to the prosperity of this country: therefore be it

Resolved, That a committee of five members be appointed, whose duty it shall be to inquire and report whether it be expedient for the Board to institute an investigation into the probable causes of these accidents, and the proper remedy to be applied to prevent their recurrence.

Messrs. Wm. H. Keating, George Fox, Isaiah Lukens, M. W. Baldwin, and Samuel V. Merrick, were appointed on said committee.

At a subsequent meeting of the Board, held June 10th, 1830, the above committee made the following

REPORT:

The committee appointed by the Board of Managers of the Frank-

lin Institute, to "inquire whether it be expedient for this Board to institute an investigation into the probable causes of the accidents in steam boats, and the proper remedy to be applied to prevent their recurrence," respectfully report:—

That, after mature reflection, and consultation with many of the members of the Institute, they are decidedly of opinion that such an investigation, if undertaken in a proper manner, and carried on with perseverance, cannot fail to lead to interesting, or even important results. The application of steam to navigation has been attended with such unforeseen advantages to the world at large, and to our own country in particular, that no series of accidents in steam boats, however frequent in their recurrence, or fatal in their consequences, could probably deter the public from the use of them; but if the boats shall continue to run unrestrained by any regulations whatsoever, they must occasion a serious waste of property, and what is much more lamentable, a great destruction of life. These accidents ought not by any means to be considered as an unavoidable consequence of steam navigation. They proceed, it is believed, in most cases, from defective machinery, improper arrangement or disposition of the parts, or finally, from carelessness in its management. That the causes of accidents may be partially, if not wholly, removed by salutary regulations, appears highly probable; and that there must be a power in the community, lodged somewhere, to protect the people at large against any evil of serious and frequent recurrence, is self evident. But that such power is to be used with extreme caution, and only when the evil is great, and the remedy certain of success, seems to be equally indisputable.

To determine what regulations, if any, should be adopted, it is necessary first of all to ascertain the true causes of these accidents. This requires an attentive examination into the circumstances of each explosion, and is a task that will demand extensive correspondence and interchange of ideas. It should be undertaken with a single view to the benefit of the public, and to the complete perfection of an invention which has brought unparalleled honour upon the American character. It should be made apparent, to all such as may be called upon for their advice or opinion in the matter, that the investigation is founded upon the kindliest motives, and not accompanied by a willingness to fetter that branch of industry by any unnecessary regulations. With this view, it appears to your committee that the inquiry can best be carried on by a public body whose views are so well known and appreciated by the community, as to place their motives beyond suspicion. That the subject is one of the utmost importance, is evident from the fact that the congress of the United States have twice entertained the question, and that the parliament of Great Britain, as well as the government of France, have deemed it worthy of their peculiar care. Could the question meet with that thorough discussion and investigation before a committee of congress which its importance and difficulty require, we would forbear from recommending to the Institute to take any steps in it; but as it is well known that from the many subjects which press upon the at-

tention of congress, and from their indisposition to follow the British precedent of instituting inquiries founded upon the personal evidence of practical men, it becomes a difficult task for a committee of their body to possess themselves of a knowledge of the facts that have been developed, during an experience of twenty years, over so extensive a country as ours. It appears to us that such an investigation must first be undertaken by those who are most conversant with the subject, and who, as representing a large body of mechanics, are desirous of seeing the arts free and prosperous, and as forming themselves a part of the nation, are interested in the passage of all laws, the object of which is the protection of the lives and property of their fellow citizens;—that our society constitutes such a body, no one will doubt. To collect all the information they may be able to obtain on this subject, to digest this information, and to deduce from it such conclusions as it may naturally suggest, appears to us, therefore, to be a fair and legitimate exercise of the trust reposed in this Board; indeed, we are fully confirmed in this position, by the interesting discussion which was spontaneously elicited at one of the late meetings of the Institute, in which many members expressed their strong belief that the subject ought to be inquired into: and as it can best be done by eliciting the opinions of many who are not included in this Board, we would suggest the appointment of a large committee, taken from the members of the Institute, to whom the following questions shall be submitted:—

1st. What are the probable causes of the explosions of boilers used on board of steam boats?

2nd. If any, what are the best means to obviate the recurrence of these evils, or to diminish the extent of their injurious influence, if they cannot be wholly guarded against?

3d. By what means can these remedies be applied and enforced?

Whereupon, on motion, the above report was accepted, and a committee were appointed with instructions to prosecute the inquiries set forth in the foregoing report, and to report their results to this board.

Circular letter of the Committee appointed at the above named meeting of the Board of Managers, to inquire into the causes of the explosion of the Boilers of Steam Engines.

"The Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts," have had their attention lately called to the subject of the explosion of steam boilers, by the lamentable number of accidents that have occurred in steam boats during the present season; and by the painful circumstances which have in many cases attended these accidents. They have long had the subject before them, and are impressed with the hope, that those explosions were produced rather by imperfection in the construction, arrangement, or management of the machinery, than by any inherent and irremediable source of danger in the invention itself. Feeling a high interest in the promotion of the success of the mechanic arts,

and especially of that of steam navigation, which with pride they consider as peculiarly the offspring of American ingenuity and perseverance, they have appointed the undersigned a committee for the purpose of inquiring,

1st. What are the probable causes of the explosions of boilers on board of steam boats?

2nd. If any, what are the best means to obviate the recurrence of these evils, or to diminish the extent of their injurious influence, if they cannot be wholly guarded against?

3d. By what means can those remedies be applied and enforced?

We are aware, that no investigation of so difficult and extensive a subject, can be productive of good, unless it occasion a concentration upon one point, of all the information that results from the use of steam boats over so vast a country as ours, during a period of upwards of twenty years. With this view, we beg leave to call your attention specially to it, and to request that you may be pleased to communicate to us the result of your observation, experience or reflection, on these interesting questions. We shall feel thankful to you, particularly for an account of any explosion, which may have occurred in your vicinity, or under your observation, or of which you may have obtained correct information. By collecting the *facts* in a number of cases, we may be able to arrive at some satisfactory conclusions, as to the causes which produced them; we are aware, that these may have been different, in different cases, and although we are by no means prepared to assume it as certain, that a simple and efficacious remedy will be devised, yet we hope that such a one may be found, and one which will not unduly interfere with the rights of individuals, or with the freedom of commerce and industry.

We had at first proposed to draw up a series of questions for publication and circulation, but upon mature deliberation prefer to leave the subject open, assuring you, that any information or suggestion will be thankfully received, and duly acknowledged in the report which we shall make of the result of our investigation. We beg leave, however, to suggest a few general heads, which may direct your attention to those points upon which we are chiefly anxious to obtain information, viz.

The Boiler.—Its size, form and relative thickness, the material from which it is made, (of copper or iron, &c.) if of iron, whether of foreign or American iron, especially in the boilers that exploded.

Safety Valve.—Its form, size, load in proportion to the thickness of the boiler, liability to get out of order, facility of repair, number used, location.

Supply of Water.—Mode of insuring a sufficiency, how gauged?

Arrangement of the Boilers in the Boat; which is the least liable to accident?

Construction of the Boat—to avoid the accidents in the boilers.

In addition to these, we will add, that our wish is that the investigation should take the widest range, and we beg that you will give the same scope to your answer.

Please direct your reply to Mr. William Hamilton, Actuary of the Franklin Institute.

W. H. KEATING,
ROBERT HARE, M. D.
SAMUEL V. MERRICK,
ALEXANDER DALLAS BACHE,
ISAIAH LUKENS,
JAMES J. RUSH,
JAMES RONALDSON,
FREDERICK GRAFF,
R. M. PATTERSON, M. D.
J. K. MITCHELL, M. D.
BENJAMIN REEVES,
GEORGE FOX,
THOMAS P. JONES, M. D.
WALTER R. JOHNSON,
M. W. BALDWIN,
JAMES P. ESPY,
GEORGE MERRICK.

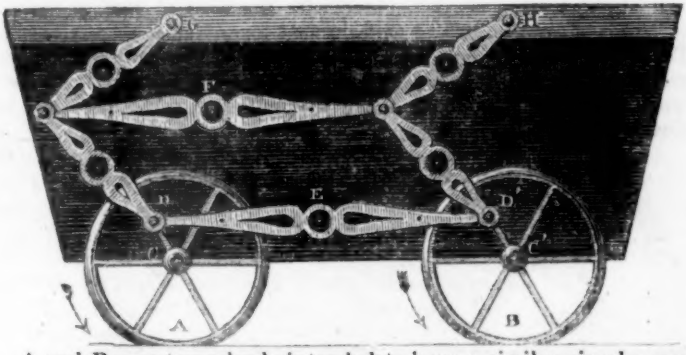
New method of communicating Circular Motion in a lateral direction.

By WM. HOWARD, Esq. United States Civil Engineer.

TO THE EDITOR OF THE JOURNAL OF THE FRANKLIN INSTITUTE.

SIR,—So far as I am informed, the arrangement which I describe below, is new. It is possible, however, that your extensive knowledge of machinery, may include it in your list of "Modern Antiques," as having been thought of long ago: but if not, I would be obliged to you to insert this paper in the Journal.

WM. HOWARD.



A and B, are two wheels intended to have a similar circular motion, round their centres C and C′, E, F, G, H is a system of parallel rules, attached to the pins or cranks D and D′, and also fastened to the points G and H, which points are immoveable with regard to the centres C and C′. From a little consideration of the above sketch, it appears that the line DD′ being always parallel to GH, and the distance of D and D′ apart being invariable on account of the connecting bar, one of these points must exactly describe the curve described by the other.

I have sent you a drawing of the manner in which I have applied this arrangement to a small model of a locomotive engine, for which it was contrived, and have found it to work very well. The imperfection of the toggled chain, formerly used in such engines, and in cot-

ton machinery, has, I believe, caused it to be generally laid aside. In some of the engines lately made in England, a connecting bar, similar to the above, has been used, but without the addition of the parallel rules.

MODERN ANTIQUES, No. 3. *By the Editor.*

Economical mode of Transmitting Motion. Invented by Mr. JOHN M'DOWALL, *Vauxhall. From the Register of Patent Inventions, for October*, 1829.

"MOTION is often required to be communicated to machinery at a distance from the first mover, and this is usually effected by a metallic shaft, which, if the distance between the machinery and the first mover be great, must be made of considerable thickness to prevent its being twisted to pieces by the power applied, or else by chains, straps, or ropes, to prevent the slipping of which on the drums or pulleys over which they pass, causes considerable impediment to the motion, by friction. These are inconveniences which cannot in all cases be avoided; but, under some circumstances, the following method of transmitting motion, through the medium of three rods and two triple cranks, connecting the machinery with the first mover, might be introduced with considerable advantage.

"The apparatus is represented with the axes of motion placed horizontally by Fig. 1; and with the axes placed vertically by Fig. 2. The same letters represent similar parts in both figures. It will be perceived that the motion may be in the direction shown by the arrows, or the contrary; and hence the motion may be reversed at pleasure.

Fig. 1.

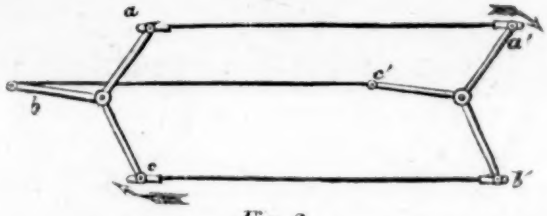
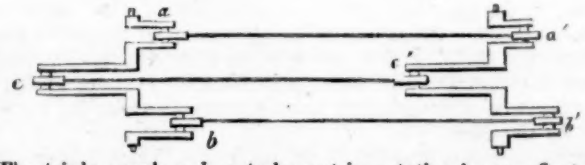


Fig. 2.

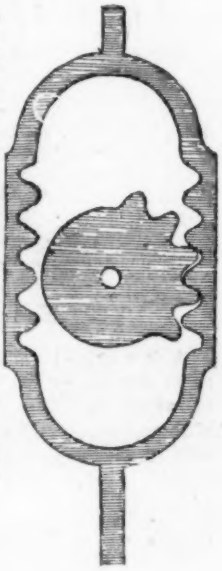


"The triple crank *a*, *b*, *c*, to be put in rotation by any first mover is connected by three rods to a similar crank, *a'*, *b'*, *c'*, of equal dimensions; and as the cranks project from the axes at equal dis-

tances, there will always be one of them in a position to produce a pulling action, and hence there will be no necessity for having the conducting rods stronger than merely to sustain by tension, the resistance of the machine to be put in motion; and thus the expense of transmitting motion, by this method, to a considerable distance, will be very small. The motion, too, will be perfectly uniform, for, as the leverage of the crank *a*, for instance, diminishes by its rotation, that of the corresponding crank *a'* will be equally diminished; so that whatever motion is produced by the first mover will be faithfully transferred to the machinery."

Perhaps we ought not to place the foregoing under the head of Modern Antiques, as our first acquaintance with it is of only thirty years standing; nor do we dispute the claim of Mr. M'Dowall to the title of inventor; we only know that either he must have invented it many years ago, or he was not the first inventor. The late ingenious and venerable Charles Wilson Peale, the founder of the Philadelphia Museum, devised and applied this apparatus to communicate motion from a turn-stile entrance upon the stairs of his museum, to a set of bells, which, in a distant part, gave notice of the approach of visiters. We have no doubt that Mr. J. J. Hawkins, engineer, London, has a perfect recollection of this contrivance, as it was in use previous to his return to England.

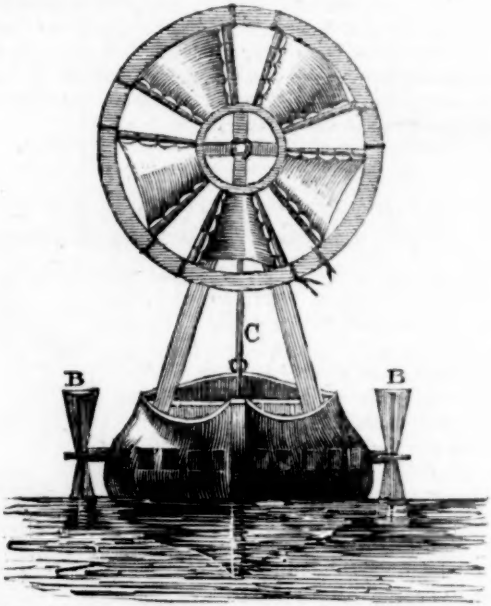
To communicate a vertical motion to a Piston, by means of a continued rotary motion of a crank. Proposed by M. Auger.



In the 4th volume of *Machines Approuvées*, page 19, under the date of 1721, we find the contrivance represented in the accompanying cut. Those familiar with machinery know that under various modifications it has been applied to the pistons of steam engines. In the present instance the motion was to be communicated from the section wheel to the piston, whilst in the steam engine this is reversed. There is in the French account a description and drawing of an appendage to the piston, not here represented, intended to secure the engaging of the teeth of the wheel into those of the racks as they change from one to the other. The patent office, and the domestic and foreign journals, are ready to give testimony that this invention merits a place in the society in which we have placed it. If its merits, however, are to be tested by its utility, neither its ancient or modern inventors have any great cause for boasting.

On the construction of a vessel moved by the force of wind, and propelled directly against it.

There are as many believers in this, as there are in perpetual motion. M. De Quet proposed it in the year 1714, and it has its place among the *Machines Approuvées*, whence we have taken the subjoined cut. The same thing was patented by Hull Chase, in August, 1828. How often it had been previously patented we have not inquired; we know, however, that models, drawings, and descriptions, have been presented at the patent office, and elsewhere, and more than one anxious wight has expressed his fears lest some one should rob him of the invention. M. De Quet says that the sails fixed in the way which he directs, will cause "the vessel to advance in a course directly contrary to that of the wind;" and Mr. Chase, 114 years afterwards, testified that he had actually verified the assertion, and patented the new discovery.

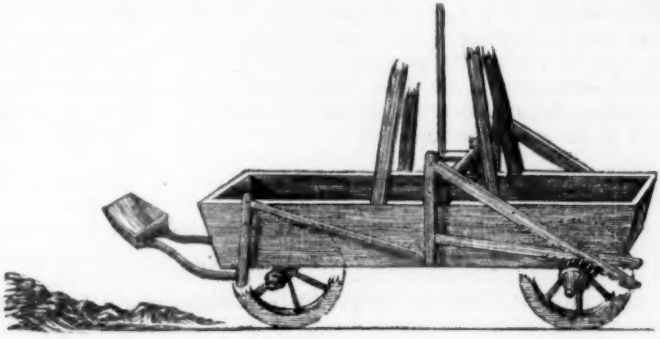


A is a circular hoop, or wheel, to which gib sails are attached, so as to revolve by the wind. The axis of the wheel turns the shaft C, which operates upon the revolving paddles B, B, which, if the wind can communicate a thousand times more force than it possesses, will cause the vessel to advance in the wind's eye.

A self-loading cart propelled by wind.

M. De Quet proposed also to apply the same kind of wind sails

to propel a cart, and cause it at the same time to load itself. We have not thought it necessary to show the sails, in the accompanying sketch, as they are seen in the last figure. The wheels of the vessel, and those of the cart, were to be driven by the same kind of machinery, the action of which may be seen on the hub of the hind wheel, which was to be acted upon by a kind of a rack and pinion motion, the hub, or nave, having teeth around it, and the two levers with corresponding teeth are alternately to be brought into operation.



FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Reply to the Query respecting the Sinking of an Iron Pot in the sea.

Sir,—In the Journal of the Institute for May, p. 327, is the following query.

"Suppose an iron pot be dropped into the sea, with its mouth downwards, and one cubic foot of inclosed air by its buoyancy prevents it from sinking; the addition of one pound of the same metal places the vessel in an equilibrio at the surface, but two pounds being added, it sinks."

"1st. If it descends in an upright position so as to prevent the escape of air, and it be not intercepted by the bottom of the sea, at what depth will it become stationary?"

"2nd. At its stationary depth will the removal of the extra two pounds weight cause the vessel to rise again to the surface?"

In answer to the first query, I say, the pot will not become stationary till it reaches the bottom, for as it descends, the air becomes more and more condensed, and of course the water rises higher and higher in the pot, and the specific gravity of the whole mass is increased; the pot will, therefore, descend with an accelerated velocity till it reaches the bottom. The second question being founded on an impossible supposition, requires no answer.

Is it possible the querist imagined that the air within the pot, by its increased elasticity and pressure, would finally force the pot up-

wards, forgetting that the pressure of the water downwards on the outside, increases as fast as that within.

So far, however, from this being the fact, it will easily be perceived that if the pot should sink more than 850 times 33 feet, and thus the air be compressed into less than $\frac{1}{850}$ of its former bulk, its specific gravity would be greater than that of water, and, therefore, sink by its own gravity to the bottom, never to return, even if the pot should be drawn up by force.

Nay, further, if the sea is 14 times the above depth, a mass of air at the bottom of it would be pressed into a space 14 times 850 times less than it occupied at the surface of the earth, and so be equal to mercury in its specific gravity. For air is 850 times lighter than water, and water is 14 times lighter than mercury, and so far as experiments have been yet carried, the density of air is in proportion to the weight put upon it. J. P. ESPY.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Improvement in the Steam Engine.

MR. EDITOR,—It is pretty generally admitted that a *deficiency of water* in steam engine boilers is one of the most frequent causes of their explosion. The rapidity with which iron when heated may be oxidized by steam, and the nature of the products thus formed, are well known. When the water in the boiler is suffered to sink below the surface upon which the fire immediately acts, this oxidation takes place, the metal becomes *burned out*, and eventually yields to the force of the confined steam.

The most common method, at present, of ascertaining the state of the water in the boiler, is by means of *gauge cocks* placed one above the other in the front of the boiler. As these indicate either an excess or deficiency of water, the *hot water pump* is accordingly adjusted.

When an engine runs regularly, it is not difficult, by this means, to make the supply of water to the boiler equal to the evaporation. This method, however, under the charge of a skilful engineer, requires his utmost care and attention. Every variation that takes place with regard to the load with which the engine labours, or the velocity with which it runs, tends to disturb the equilibrium (between the supply of water to the boiler and the evaporation,) attained by any previous adjustment of the pump.

When a temporary stoppage of an engine is necessary, as for taking in or discharging passengers, the fire is rarely abated to such a degree as to prevent all further evaporation. The supply from the pump being now *cut off*, the water in the boiler sinks rapidly, and, in all probability, *as delays, though dangerous, are not uncommon*, before the machinery is worked again to replenish it, the mischief is over.

From the foregoing brief description of the present method of

regulating the *feed* of the boiler, and the difficulties attending it, it will be obvious that in the hands of a careless and inattentive engineer, its purposes must be often defeated.

With a view to lessen the number of these accidental explosions, the following contrivance has been *recently patented*, for enabling the engine to regulate for itself its own proper supply of water to the boiler.

In the *pipe* which conveys the water to the *hot water pump* of the engine, I propose to place a cock or *valve;* the latter, however, and of the kind denominated the *throttle-valve*, is recommended. This valve is a circular plate of metal, made to fit the bore of the pipe, and is moveable upon an axis, which passes diametrically across the plate; on the end of the axis which comes through the pipe, a small *handle* is fitted to communicate motion to the valve, which being turned edgeways in the pipe, presents scarcely any resistance to the passage of the water to the pump; but when turned flat across the pipe, closes the bore. This kind of valve may be fitted, without any *extraordinary care*, sufficiently accurate to answer its purpose.

To operate upon this valve, a *float*, attached to the end of a *rod*, is placed on the surface of the water in the boiler, the other end of the rod is connected with an axis or *spindle*, upon which the float works as a centre. This spindle may be fitted in a small *cap* placed upon the top of the boiler, but in many cases the lower end of the tube of the *safety valve*, or of the *steam pipe*, will be found convenient. On the end of this spindle, which is made to protrude a few inches on the outside of the boiler, another rod termed the *index*, is fitted and connected with the handle of the valve above mentioned.

It will be understood that the stroke of the pump must be adjusted to furnish the *greatest quantity* of water the boiler may at any time require: that the length of the *rod*, *index*, and *handle* of the valve are so apportioned to each, that when the *float is at, or near*, the lowest point to which it is thought prudent to allow water in the boiler to subside, the valve shall then be entirely open, and a free passage given for the *maximum quantity of water* to pass into the chamber of the pump. But when the float is at the highest allowable point, the valve shall then be closed, and the supply of water to the pump, and *consequently* to the boiler, cut off.

Under these circumstances it will be readily seen that so long as the operation of the engine is continued, this contrivance must keep the surface of the water in the boiler *always* between the above prescribed limits, whatever may be the rate of the evaporation, or of the running of the engine.

The index, as its name imports, will serve constantly to inform the engineer, and others, of the condition of the water in the boiler. A scale may be placed aside of it for the purpose of pointing out the several rates of evaporation, and also to show when the engine, or *hand pump*, if it is provided with one, should be worked to replenish the boiler when the water is getting low during temporary stoppages. On boats, this part of the contrivance should be made as *public as possible*.

The above described apparatus, it is believed, will, by keeping the water in the boiler constantly at any level that may be desired above the action of the fire, prevent (as I have hastily endeavoured to show) one of the most frequent causes of explosion.

As the pumps of an engine are liable to become defective, the supply and feed pipes to get choked, &c. in some of which cases the safest mode of proceeding is to put the fire out as quickly as possible, I therefore suggest that the *lever of the safety valve* be made slanting, or inclined; that the weight to be suspended on it be retained by a *spring* or *lever hook;* and that this hook be connected with the index of the float, and so adjusted that when the float has sunk to any certain point, considered dangerous, the weight on the lever shall become unhooked, and allowed to *slide nearer the fulcrum.* The noise of the steam *blowing off* at the safety valve will act as a *tell-tale,* or *alarum,* to call the engineer to his duty. The float may be otherwise made to act upon a *small cock* in the boiler for the same purpose.

The descent of the weight may be very readily made to close a damper; to let *fall the grate bars of the furnace, &c.* instantly, or at any *reasonable time after* the alarm has been given, and thus by putting out the fire, prevent all danger, and any injury the boiler might otherwise sustain.

The self-acting feeder that has just been described, it is thought, will tend much to the *preservation of all boilers* to which it may be applied. It differs from other contrivances for a similar purpose, in being applicable as well to *high* as to *low* pressure engines, requires no waste pipes, &c.

Very respectfully, yours, &c.

CHARLES POTTS.

Philadelphia, June 23d, 1830.

P. S. Individuals who may feel disposed to attach the self-acting feeder to their engines, can have it put up in a neat and substantial manner, and at a moderate expense, by applying at the establishment of Messrs. Rush and Muhlenberg, Bush Hill, in the vicinity of the city of Philadelphia. C. P.

On the Explosions of Boilers of Steam Engines. *By* M. ARAGO.

[From the Annuaire du Bureau des Longitudes, 1830.]

TRANSLATED FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

(Concluded from page 414.)

Explanation of the explosions which are preceded by the opening of the safety valve, or by a diminution in the elasticity of the steam.

How does it happen that a boiler bursts at the very moment of the opening of the safety valve? How does it happen that this accident is almost always preceded by an apparent diminution in the elasticity of the steam?

These questions, involving seeming paradoxes, are suggested by the accidents recorded in this paper.* Mr. Perkins has, I think, answered them satisfactorily, and I shall lay before the reader the explanation given by that engineer.

In a boiler of the common construction, when the flame from the furnace does not rise higher than the level of the water within, the metal and the liquid inclosed are of the same temperature. This is no longer the case when there is not a proper supply of water in the boiler, and when the flame rises high; then, parts of the boiler may be heated even to redness; in such a case, the steam in contact with the intensely heated metal would become very hot, and yet not acquire great elasticity, either because it is not fully saturated with moisture, or from another cause which I shall explain hereafter.

The water within the boiler being thus low, and the steam which presses upon its surface very much heated, but of little elastic force, suppose the safety valve to be opened: a copious discharge of steam takes place; the water relieved from the pressure upon its surface, rises up in foam, the action being similar to that which takes place in a Champaign bottle on drawing the cork; the water thus thrown in small drops into the midst of an intensely heated vapour, flashes into highly elastic steam, the safety valve not affording a sufficient vent for the discharge of the steam, the boiler is rent.

There are three hypotheses in this explanation. The first is, that the part of the boiler, above the level of the water within, may become intensely heated, and may communicate heat to the steam within, without affecting, materially, the temperature of the water upon which this steam rests. The second is, that boiling water is projected to a certain height in the form of froth as soon as the elasticity of the steam pressing upon its surface is suddenly diminished. The third, that water thus disseminated through a mass of heated steam, is itself suddenly flashed into steam.

No one, I think, will refuse assent to the first hypothesis. If a metallic vessel placed upon a fire does not become heated to redness, it is because the water within, continually deprives the metal of the heat which it receives from the fire, thus preventing an accumulation of heat in the metal. Steam could not produce this effect in the same degree. If the flame from the furnace should play upon a part of the boiler above the level of the water within, this part might become heated to redness, and communicate its temperature to the steam in contact with it; this stratum of steam, in its turn, would communicate the same temperature to an adjacent stratum, and so on, until the heat should be disseminated through the body of steam occupying that portion of the boiler not containing water, that is, through the steam reservoir. There are examples of these effects. Mr. Moyle, in visiting his engines in Cornwall, found that one of the boilers had become so hot that a wooden scale resting *upon the top* of the boiler had taken fire. A similar occurrence took place on board of one of the packets between Liverpool and Dublin; a pine board, accidentally thrown upon the cover of the boiler, took fire. I have already stated,

* See vol. v. page 403.

that before the accident at Pittsburgh, the engineer had observed, for some days, that one of the boilers became heated to redness. I will now give a direct experiment of Mr. Perkins, upon this subject.

A cylindric boiler, of four feet in length, and one foot in diameter, having been placed, vertically, over a furnace, the base was surrounded by a fire, which rose to one-third of the height of the cylinder, while the water occupied but one-sixth. Thus two-sixths of the surface of the vessel were exposed to the heat, one-sixth above, the other below, the level of the water within. The safety valve loaded with about one atmosphere, was placed in the side of the boiler, half way up. Water was supplied to the boiler so as to make up for the loss from the escape of steam.

A thermometer immersed in the water, and going down to the bottom of the vessel, indicated a temperature of 104° (219° Fah.) The temperature of the stratum of steam resting upon this water was the same, but half way up the boiler a thermometer stood at 260° (500° Fah.) and the metal was *red hot*.

The first hypothesis being established, we pass to the second.

There are liquids which, when boiling, are thrown upwards with violence; sulphuric acid is one of these; milk is another example, but the commotion is not so violent as in the case of the acid. If we examine, attentively, water while boiling, we shall see that, at times, small drops are thrown upwards to some distance. This action depends evidently upon the viscous nature of these liquids, and on the difficulty with which steam, generated at the lowest part of such liquids, finds its way through them. When the quantity of confined vapour is great, and it is prevented from escaping by a pressure upon the surface of the liquid, it is easy to see that if the pressure be suddenly removed, instead of rising gradually, as in ordinary circumstances, it will escape very rapidly; that the liquid will froth, as though impregnated, under pressure, with a gas, will become a kind of foam, consisting of water and steam, will have its bulk very much increased, and will expand throughout the boiler. A direct experiment, made in a transparent vessel, would show how far these deductions are correct; wanting this, we conclude by reasoning from analogy, that, as Mr. Perkins asserts, in case of a sudden diminution in the elasticity of the steam within the boiler, the water may rise above its level, and its foam may fill the whole of the steam reservoir.

Let us pass to the third hypothesis of the American engineer, viz. the *sudden* conversion of water into steam. Here we shall have direct experiments to guide us.

Mr. Perkins having filled one of the metallic cylinders, which he terms generators, with water, raised its temperature to 500° Fah. By the side of this cylinder was placed a close receptacle containing neither water nor dense vapour, its temperature being about 650° Fah. These two vessels communicated through a tube, usually closed by a valve.

It is evident that if, by means of a forcing pump, a small quantity of water be thrown into the generator, an equal quantity of the hot

water within must be forced out, and opening the valve connecting the generator with the receiver, must pass into the latter, when, by the use of a properly adjusted valve, it might be made evident whether the water was converted suddenly into steam or not.

Mr. Perkins states that the conversion of the water into steam was instantaneous; that the injection pump had hardly made its stroke, when the valve of the recipient indicated a pressure, from the elasticity of the steam within, of forty atmospheres, when a moderate quantity of water was injected, of one hundred, when the quantity injected was great.

If this experiment had been made with water heated to from 212° to 250° Fah. it would show, exactly, what must take place in a boiler of the common kind. Since the temperature of the water used, 500° Fah. is far below that of steam, having an elastic force equal to 100 atmospheres, this experiment further shows that a portion of the water has flashed instantly into steam, on leaving the generator.

It cannot be inferred from the experiment just given, that the water is flashed into steam by the agency of a very rare steam, the temperature of which is that of red hot iron. This part of the opinion of Mr. Perkins, as has been remarked by M. Dulong, could hardly be reconciled with the known laws of the specific heat of steam. We are, therefore, induced to believe that the American engineer was wrong in supposing, that the heated metal had no direct agency in the results observed.

Let us now examine whether, setting out with the fact of the sudden conversion of water, in contact with intensely heated metal, into steam, we can give a satisfactory explanation of all the accidents which have been detailed in the former part of this paper.

The explosion described by M. Gensoul* confirms precisely the view taken by Mr. Perkins. It may be explained by supposing that on turning the cock, thus giving vent to the steam in the boiler, the water, suddenly relieved from the pressure which it had borne, rose in foam within the boiler, and being thus thrown in contact with the faces of the boiler, which were, probably, highly heated, it was converted so rapidly into steam, that the cock did not afford a sufficient vent for its escape.

The same reasoning applies to the experiment of MM. Sabareau and Rey,* for their boiler being very small and exposed directly to a charcoal fire, the part above the level of the water might have been surrounded by flame. In the experiment† made by M. Dulong and me, no increase of pressure resulted from opening the safety valve, because, the boiler being large, and the opening through which the steam issued small, the elasticity of the steam within was very gradually diminished; besides which, the boiler was placed upon a bed of masonry, and only the part containing water was exposed to the fire. The diminished action of the engine, which preceded the explosion at Essone,‡ the one at Paris,§ and that of the Etna in America,‖ seems to me to be accounted for naturally, by the cause assigned for it by

* See vol. v. page 404. † Ibid 405. ‡ Ibid. § Ibid. 404.
‖ Ibid. ¶ Ibid.

Mr. Perkins. It has been seen, that when the explosion has happened in consequence of some defect in the feeding pump, or in the pipe leading from it to the boiler, the level of the water in the boiler was lowered; now the quantity of steam, generated in a given time, depending upon the extent of heated metallic surface in contact with the water, if this extent were calculated, at the original level of the water in the boiler, to afford a due supply of steam to the engine, it follows that when this extent has been diminished, by a reduction in the level of the water, the boiler can no longer furnish a quantity of steam sufficient to supply the wants of the engine. It might be supposed that the increased temperature of the steam, produced by contact with the heated sides of the boiler, by increasing its elasticity, should compensate for the diminution in quantity; it is easily shown that this cannot be the case. The steam contained in a given vessel must every where be of the same elasticity. The elasticity of the stratum of steam in contact with the water in the boiler, is determined by the temperature of that water; the upper strata must have the same elasticity with the one in contact with the water, hence the steam heated by contact with the sides of the boiler, must have an elasticity determined by the temperature of the water. The boiler will contain steam of a density less than that of saturated vapour of the same elasticity; this is all that can take place.

Mr. Perkins supposes, that the very moment in which the explosion takes place, is that at which the safety valve opens; the steam within the boiler has then reached the limit of elasticity under which the engine was to work; at this very limit the piston of the engine must move slowly, for the steam, being much warmer than the metal of the engine, must lose much of its heat, by imparting it to the cooler metal, and therefore much of its elasticity.

It would, I think, be fruitless to endeavour to determine from this, or from any other theory, the form of the line of rupture of the boiler, the number and size of its fragments, the directions under which they will be projected, &c. &c. A thousand circumstances would modify these results, in ways which it would be difficult to determine, even if the action took place slowly and before our eyes. It happens, however, so often that the line of rupture is horizontal, that it appears natural to suppose this line to have marked the level of the water within the boiler, at the time of the explosion, and therefore it is a curious question to determine why this line, notwithstanding the inequalities in thickness of the metal at different points of it, should be the line of least resistance. This fact can, I think, be explained as follows.

At the very instant which precedes an explosion, the elasticity of the steam is very much, and very suddenly, diminished. This must produce a flexure in the boiler towards the interior; but, as this motion is communicated suddenly, the inertia of the liquid will prevent its immediate effect upon that part of the boiler which contains water, since this inertia cannot be at once overcome.

The boiler will then be caused to bend inwards, along the line of level of the water which it contains. But we have seen that the

formation of a highly elastic steam follows immediately the opening of the safety valve; by this steam, the sides of the boiler will be pressed outwards. Now even if we suppose this force to act, at the same instant, equally on every part of the boiler, still that part containing the liquid will not yield at once to the impulse, for reasons stated in considering the inward flexure. The level of the water in the boiler, before the explosion, will therefore trace, upon the faces, the line in which the flexures, both inward and outward, ceased to produce an effect, the only line along which contiguous particles of metal have not the same motions. We need have seen but once the ease with which plates of metal are broken, by bending suddenly in contrary directions, along a certain line, to understand why the line of level of the water within the boiler, inasmuch as it is the hinge about which the two flexures take place, should usually be the line of rupture, although, as at Lyons, it would not be, if we had regard only to the thickness of the metal, every where the line of least resistance. It is important further to remark, that this is the line along which the metal becomes of a higher temperature than the water within, and which consequently divides the boiler into two parts of very unequal tenacities.

The almost simultaneous explosion of several boilers employed in supplying the same engine, was noticed, in a former part of this paper, as a fact worthy of attention, and one which it was important to be able to explain. Would this explanation be difficult, if we admit, with Mr. Perkins, that an explosion is generally produced by the depression of the level of the water in the boiler, and the heating of the metal above this level? Might we not say that these circumstances generally occur at the same time in the several boilers? since they are fed by the same pump, and since, as soon as the engine moves slowly, the firemen would naturally urge the fire in each furnace. This being the case, let us suppose that one of the boilers bursts on the opening of its safety-valve. The pipe, through which steam passed from this boiler to the cylinder of the engine, is open to the air; each boiler has a similar pipe, and all terminate in one and the same pipe. By this means, the second, third, &c. boilers communicate with the atmosphere; the steam which they contained pours forth through this wide opening, and, in an inappreciably small portion of time, the circumstances producing explosion are to be found in each boiler, without the necessity of supposing that the safety-valve of each was raised at the same instant.

I have spoken* of a boiler which exploded in the air. In all probability, when that at Lochrin burst, it was twelve or fifteen feet above the bed of masonry which usually sustained it. Although this fact can be equally well explained, by several theories which have been advanced to account for explosions, and therefore cannot determine us to adopt one of them rather than another, still it may not be superfluous to show that it can be perfectly well explained by that of Mr. Perkins.

* See vol. v. page 406.

The supposition was an erroneous one, that a boiler composed of metallic plates, must, necessarily, remain in its place, when an opening should be made in any part of it. This error, into which, for example, many of those who contrived the portable gas lamps fell, might cause severe accidents. It is true, that a vessel completely closed remains at rest, whatever be the elasticity of a gas within it; but this is because the pressure upon any point of the vessel is exactly counterbalanced by that upon the opposite point. The effect of a pressure from within, upon the top of a vessel, tends to raise the top, and, if the force were sufficient, the top would rise, were it not that the pressure upon the bottom, in a contrary direction, is exactly equal to, and destroys, the first force. Now it is evident that the same effect is produced, whether we destroy this downward force or take away the part of the boiler which served as its support.

The unresisted force which produces motion in cases analogous to the preceding, is called *reaction*. An example of the effect of this force, is afforded in the flight of the rocket; the gas resulting from the inflammation of the powder, finds on one side no resistance, and on the other a base against which to act, it therefore drives the rocket forward by virtue of this action. These preliminaries established, a few words will suffice to show how, according to the theory of Mr. Perkins, a boiler may explode in the air.

The explosion is, according to this theory, always preceded by a copious formation of steam. When this steam escapes through the safety valve, placed, as it generally is, upon the top of the boiler, the *reaction* of the steam tends to press the boiler more firmly upon its bed; but if the steam escape through some fissure in the lower part of the boiler, the boiler may be projected upwards, being then acted upon by a force directed similarly to that which produces the flight of a rocket. This effect must take place if the elasticity of the steam should be sufficiently great. Add to this, that the change of situation of the boiler, producing a corresponding change in the position of the liquid within, cannot fail to give rise, independently of other causes already mentioned, to the instantaneous production of steam, which causes an explosion.

It seems then, that the theory of Mr. Perkins explains satisfactorily, all the examples of explosions which I have been able to collect, which were preceded by a decrease of elasticity in the steam. Since, in addition to this, the theory is not at variance with known physical laws, we ought immediately, if not to adopt it, at least to take the precautionary measures which it suggests.

These measures are very simple.

To prevent by every means in our power, for example, by the use of fusible metal plates, any part of the boiler from becoming heated too highly.

To pay the greatest attention to those means by which the boiler is supplied with water, or to those which indicate the level of the water within the boiler.

If, notwithstanding the precautions of the engineer, parts of the

boiler should become too intensely heated, to avoid every abrupt opening of the valves, or operations of an analogous sort, which will permit the steam, already generated, to flow rapidly into the air.

Lastly, in such a case to put out the fires as quickly as possible.

Comparison of the explanation given by Mr. Perkins with those offered by other engineers; new causes of explosions.

Although I have presented in detail, and under a favourable point of view, the explanation given by Mr. Perkins, of the causes of the dangerous explosions, which, notwithstanding the good condition of the safety valves, too often occur, I am far from considering this explanation so conclusive as not to admit of a doubt, and, in consequence, to suppose the subject exhausted. I will, therefore, now present views upon the same subject, which I have derived from the printed and manuscript works which I have been able to consult, and also will subjoin a notice of certain causes of explosion, not spoken of by the American engineer. I shall then have completed the task which I proposed to myself, namely, to give as complete a statement as was possible, of the information which has been acquired, in relation to these distressing accidents: those who may deem it necessary to extend this knowledge will know the point from which they should begin.

One of our most skilful naval constructors, M. Marestier, has offered a theory, in relation to the particular kind of accident which Mr. Perkins had in view, which, viewed as a whole, has some analogy with that of the American engineer; there is one point, however, upon which these authors differ essentially.

M. Marestier admits, with Mr. Perkins, that for some time previous to an explosion, the boiler has not received a sufficient supply of water; that one portion of the metal thus receiving the direct action of the fire, without being in contact with water, becomes heated, perhaps even to redness; that, at the moment in which the safety valve opens, or an accidental escape of steam takes place, the surface of the water is disturbed, as has been already explained, either in consequence of the violent ebullition caused by a diminution of pressure within the boiler, or by the flexure of the boiler inwards, which lessens its capacity. M. Marestier further supposes, that the water thus raised, coming in contact with the heated metal, is suddenly flashed into steam, and in such abundance, that the safety valve cannot give vent to it. In the boilers of steam boats, in certain cases, the motion caused by the waves tends to bring the water in contact with the heated metal.

The reader may recollect that Mr. Perkins attributes the sudden production of steam, to the projection of water into steam of a very low density, but intensely heated; whilst that, according to the explanation of M. Marestier, just given, it is the heated metal which suddenly flashes the water, thrown into contact with it, into steam. Nothing at first sight could appear more in accordance with reason than this hypothesis of M. Marestier, but in natural phenomena, as has been wisely remarked by Fontenelle, "as soon as two different

causes may be supposed to account for an effect, the true cause is generally that which at first seems the less probable." It is the fact, however strange it may appear, that metal heated to redness does not rapidly convert water into steam. If a drop of water be placed in a vessel heated to a white heat, its conversion into steam requires a long time, while it disappears at once if thrown into the same vessel when but moderately heated.

The only experiment which I shall cite upon this point, is that of Klaproth: a drop of water thrown into an iron spoon, heated to a bright red heat, required 40 seconds for vaporization; at the end of this time a second drop let fall into the same spoon, now partially cooled, required but 20 seconds for vaporization; a third drop disappeared in 6 seconds, a fourth in 4, a fifth in 2, and a sixth in an inappreciably small portion of time. Notwithstanding these curious observations, I have already stated, (page 47,) that the *intensely heated* metal of the boiler appears to me to play the principal part in that sudden transformation of water into steam, which causes an explosion: it must be admitted, however, that, to complete his theory, M. Marestier should be able to explain, why the water within a boiler acts differently from the drops in the experiment of Klaproth. If it were found that a drop of water, thrown violently against an intensely heated plate of metal, is instantly converted into steam, all our doubts would disappear, and the explosion of the boiler, known to have been heated to redness, at Pittsburgh, would no longer seem an anomaly, requiring new causes to be sought for its explanation. In conclusion I would remark, that Messrs. Perkins and Marestier only differ upon a point of theory. The fact of the sudden conversion of water into steam, determined experimentally by the former, is admitted by the latter, and with regard to the precautions to be taken to guard against explosion, it is of no consequence whether the heated metal acts directly or indirectly, in the formation of steam. The same care should be taken to prevent the boiler from becoming too highly heated, and if it should become, by accident, thus heated, to prevent the sudden opening of the valves.

M. Gensoul, whose name is so honourably connected with the progress of the useful arts at Lyons, explains very differently from Mr. Perkins or M. Marestier the explosive effects produced sometimes by the sudden opening of a safety valve. The following may be considered an outline of M. Gensoul's theory.

When a metallic tube is filled with a liquid very strongly compressed, a slight blow upon the face of the tube will cause it to burst, while a great increase of pressure gradually applied might have failed to produce such an effect. This fact is well known; M. Gensoul thinks it may be extended so as to apply to boilers. In his view, when the faces of a boiler have been pressed with great force, by the steam within, they should break by a small percussive force, just as if they contained a liquid subjected to great pressure; now he thinks, that the part of a boiler diametrically opposite to that on which the safety valve is placed, must experience a sort of percussive action when the valve opens suddenly, allowing the escape of steam. If,

for example, the safety valve is on the top of a boiler, the bottom will receive the percussion on the opening of the valve; if the right side of the boiler should have the safety valve attached to it, then the left would be struck, &c. &c.

This ingenious explanation raises several doubts in the mind. First, it appears by no means evident that, the interior pressure being the same, a blow can produce the same effect upon a vessel filled with a liquid and with a vapour; the incompressibility of the liquid may be of some importance in this action. Secondly, M. Gensoul supposes that before the explosion the boiler is filled with a highly elastic vapour, while, on the contrary, we have seen that such accidents often happen when the engine is working very slowly. The explanation seems at least incomplete. We may, therefore, conclude, that in cases of sudden rupture, the reaction of the steam escaping can produce no important effect; I have pointed out (page 50) the kind of accidents which may be produced by this cause.

Some persons, struck with the instantaneous effects produced by the explosions of boilers, have been induced to think that steam alone could not produce them, and have called to their aid gases capable of exploding. Why, say they, since, in the laboratory, hydrogen gas is obtained by passing the vapour of water through an iron tube heated to redness, will not the same gas be produced within a boiler in which the steam is sometimes in contact with metal heated to redness? We grant that this would account for the production of this gas. Mixed with steam, this gas will pass into the cylinder of the engine, from hence, as it is not capable of condensation, it will be expelled at a great expense of power, and the effect will be to retard the working of the engine. I will admit, if necessary, that this is usually the cause of the retardation in the working of an engine, just before an explosion, in the kind of accidents which we have been engaged in discussing; but how is this explosion produced? Hydrogen alone, or when mixed with steam, cannot explode. A mixture of hydrogen and oxygen gases, in proper proportions, will explode; but how are these gases to be produced within the boiler? The hydrogen is produced by the decomposition of water by the heated metal, which is thus oxidized; from whence then can the oxygen come? Perhaps, it may be said, from the atmospheric air contained in the water which feeds the boiler; but we may answer that this water is generally warm, that it contains, therefore, but a small quantity of air, and moreover that this air, as fast as it is disengaged from the water, passes in a state of mixture with the steam, into the engine. Further, it may be added, that the oxygen of this air would combine with the heated metal more readily than that contained in the water would do, and thus if hydrogen gas should be produced from the water, it would find nitrogen present with which to mix, but no oxygen. If even this difficulty were disposed of, we should be no further advanced. The only means known by which hydrogen and oxygen gases can be made to unite with explosion, are a solid body heated to redness, flame, and the electric spark. Boilers have burst without having reached the temperature

of redness required to produce an explosion. Flame is still further out of the question. There remains the electric spark; from whence shall we derive it? I know it has been said that the explosion of the boiler of the steam boat Enterprise, of Savannah, was caused by an electric discharge, to which the smoke from the chimney of the furnace had served as a conductor; but, supposing this to have been the case, we have no evidence that the lightning found a mixture of hydrogen and oxygen gases in the boiler, or that it did not act as it usually does, rending asunder every thing which it meets. But even admitting, with the partizans of the theory which I have just explained, that the electric spark may possibly be the cause of an explosion, I cannot persuade myself that this agent can be supposed to act, I will not say in all, but in the one-hundredth part of the cases of explosion.

Discouraged by the difficulties of uniting, in the same boiler, the gases necessary to form an explosive mixture, some engineers have supposed but one formed, hydrogen; that this gas, after the bursting of the boiler, mixing with the air in the furnace, explodes. Thus the detonation of the gases is not considered as the cause of the explosion, but as adding to the violence of its effects: this explosion taking place in the furnace would project to a great distance, the whole boiler, or its fragments, with those of the furnace. What can I say of these views, but that not a single explosion has occurred in which it has been ascertained that hydrogen, contained within the boiler, has contributed to produce it.

Let us now examine whether, as many engineers have supposed, the elements to produce detonation may not be found in the furnace itself.

According to these engineers, carburetted hydrogen will be produced from the coal, as in the apparatus for procuring coal gas, and pure hydrogen, if necessary, by the decomposition of the water, which finds its way between the imperfectly fitted plates of the boiler and falls upon the coal. As for the oxygen, without which there could be no explosion, it is derived from that portion of the air supplied by the draught, which passes through the fire without being entirely deprived of its oxygen.

The bright columns of flame, sometimes seen at the tops of the highest chimnies of furnaces, show that the gas drawn up by the draught may sometimes form an explosive mixture. If such a mixture should be formed in some corner of the flue, its explosion must be feared. If this explosion should be violent, it is difficult to conceive how the boiler could resist it.

I have already stated how an explosive mixture might be formed in the furnace itself. I must add, that there are certain accidents evidently produced by this cause, I mean the explosions of evaporating pans entirely open at the top. I am informed by M. Gay Lussac, that the furnace of a saltpetre refinery at the Arsenal of Paris, was recently destroyed entirely, by an explosion of this sort; the boiler remained uninjured.

To prevent such accidents, ascending and descending elbows in

the flues should be, as much as possible, avoided; for it is principally in these elbows that inflammable mixtures can be lodged. It is also necessary that the register of the flue should not shut too tightly, as I have explained already.* Lastly, to avoid the disengagement of combustible gas from the coal, without its being burned at the instant of its production, care should be taken to have interstices between the bars of the grate of sufficient size. If the coal is rich in bitumen, it cakes, the different pieces become so agglutinated as to form a crust, which, when very thick, is almost impervious to flame. The furnace becomes then a true apparatus for the distillation of the coal, much inflammable gas is produced, and but little heat. The coal should, therefore, be placed upon the grate in thin layers, not only from considerations of economy, but actually from those of safety. The firemen who through laziness encumber the grate with coals, retard the working of the engine, expose it to the most serious accidents, and risk their own lives: they cannot be watched, therefore, with too much care.

To complete my task, there remains but to mention a last cause of explosion, which is not without importance.

The water used to generate steam is very seldom pure. Usually this water contains saline matters, which are deposited by boiling, and which form upon the interior of the boiler a hard crust, which increases in thickness every day. Before the existence of this crust, the heat absorbed by the metal was rapidly transmitted to the water, and the boiler could never acquire a very elevated temperature; as soon as a substance which conducts heat but slowly, as is the case with the saline deposit supposed, lines the interior of the boiler, the heat reaches the water but slowly; the metal receiving, every instant, more heat from the fire than the saline deposit takes from it, becomes more and more heated, until at last it may become red hot; this is not only attended with a great loss of heat, but with great danger, for the metals when intensely heated lose much of their tenacity. We can easily see, besides, the danger lest the comparatively cold water of the boiler should, through some fissure in the saline crust, come in contact with the heated metal. In such a case a boiler of cast metal would, probably, instantly give way, and one of wrought plates would be very much strained, even if its strength prevented its bursting. I may add, that the portions of metal thus heated become oxidized very rapidly. As an example may be cited, the boiler intended to warm one of the noblest works of our capital, in which a hole was burned in the lower part, in the place upon which a workman had, by accident, allowed a cloth to fall.

We thus see how important it is that the boiler should be kept clean. In steam boats which use salt water to supply the boiler, the saline deposit should be removed every twenty-four hours, if not oftener. When the water used is pure, this operation is only necessary at considerable intervals of time. No general rule can be given on this head; the engineer should determine, experimentally, in

* See vol. v. page 405.

what way, and how rapidly, the saline elements are deposited, from the water which is used in the boiler of which he has the charge. Since the discovery that potato starch and malt prevent these deposits from taking place, it has been proposed to throw a certain quantity of these substances, from time to time, into the boiler; but I do not know that this practice has extended very widely.

I regret that it is out of my power to give an account here of the ingenious researches which M. Tabareau has made on the subject of explosions, the results of which he has presented to the Academy; it seems to me necessary to await the modifications in his theory, which he himself has thought necessary.

I ought not to conclude so long a paper on the subject of the explosions of steam boilers, without explaining why I have not separated the examples of the explosions of high pressure boilers from those of the low pressure; it is because I think there is no reason to make such a distinction. Every one must in fact admit, that at the time of an explosion, all boilers contain high pressure steam. I may add that it does not appear established by any means, that explosions take place more frequently in high than in low pressure boilers; the contrary has been maintained by different engineers, among whom may be classed Messrs. Perkins, Oliver Evans, &c.

One of my friends, after having read this article, expressed to me a fear lest so detailed an account of the various causes which might cause the explosion of a boiler, should destroy the confidence of many in the steam engine. If this essay were calculated, in my opinion, to produce such an effect, I should have been anxious to suppress it; but I cannot feel any apprehension that such an effect will be produced by it, for if it should be read with a little attention, as I have a right to suppose, the reader will see that no cause of explosion exists which cannot be avoided, by means at once simple and within the reach of every one. As we should not trust fire-arms in the hands of children, so, I think, we should not trust the direction of a steam engine to a man either unskilled, without experience, or wanting in intelligence. It is a very mistaken idea, that because steam engines usually move without attention to them, such attention is not required; Watt contended strongly against this error, and if my article should contribute to render it less common, I shall think the pains which I have taken well bestowed; such was the sole end and object of my essay.

Description of the Microscopic Doublet, invented by the late Dr. W. H. Wollaston. *Extracted from the Philosophical Transactions.*

In the illumination of microscopic objects, whatever light is collected and brought to the eye, beyond that which is fully commanded by the object glasses, tends rather to impede than to assist distinct vision.

My endeavour has been, to collect as much of the admitted light

as can be done by simple means, to a focus in the same plane as the object to be examined. For this purpose, I have used, with success, a plane mirror to direct the light, and a plano-convex lens to collect it, the plane side of the lens being towards the object to be illuminated.

With respect to the apparatus for magnifying, notwithstanding the great improvements lately made in the construction of microscopes, by the introduction of achromatic object glasses, and the manifest superiority they possess over any single microscope, in the greater extent of field they present to view at once, whereby they are admirably adapted to make an entertaining exhibition of known objects; yet hardly any one of the compound microscopes which I have yet seen, is capable of exhibiting minute bodies with that extreme distinctness which is to be obtained by more simple means; and which is absolutely necessary for an original examination of unknown objects.

My experience has led me to prefer a lens of a plano-convex form, even when made of glass; but the sapphire lens of this form, recently introduced into use by Mr. Pritchard, has a decided superiority over every single lens hitherto employed.

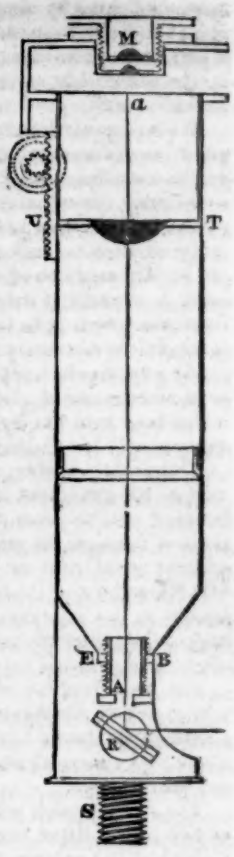
The cost, however, of such a lens, in comparison with glass, as well as the readiness with which any number and variety of the latter kind can be procured, led me to consider what simple combinations of them might perhaps equal the sapphire lens in performance, without great cost or difficulty of construction. And though both Mr. Herschel and Professor Airy have recently applied their superior talents to the analytical investigation of this subject, it seemed not improbable, that the more humble efforts of a mere experimentalist, might be rewarded by some useful results.

The consideration of that form of eye-piece for astronomical telescopes called Huygenian, suggested the probability, that a similar combination should have a similar advantage, of correcting both chromatic and spherical aberration, if employed in an opposite direction, as a microscope.

The construction which I found convenient in my trials, consists of two tubes, fitted one within the other by screwing, and each perforated at the extremity. By this construction, two suitable plano-convex lenses, fixed in these perforations, may, because of their plane surfaces, have their axes easily placed in the same line; and their distance from each other may be so varied, by screwing, as to produce the best effects of which they are susceptible.

As far as my trials have hitherto gone, I am led to consider the proportion of three to one as nearly the best, for the relation of the foci of these lenses; and their joint performance to be the most perfect, when the distance between their plane surfaces is about one and four-tenths of the shorter focus. But as all the lenses I possess are not similar segments of spheres, or of the same relative thickness, I could not expect exact uniformity in the results.

The following is a description of the apparatus which I have employed.



The figure represents a brass tube, about six inches long, and of such a diameter, as to preclude any reflection of false light from its sides; and the better to insure this, the inside of the tube should be blackened. At the top of the tube, or within it, at a small distance from the top, is placed either a plano-convex lens U, T, or one properly crossed, so as to have the least aberration, about three-quarters of an inch focus, and having its plane side next to the object to be viewed; and at the bottom, is a circular perforation, A, of about three-tenths of an inch diameter, for limiting the light reflected from the plane mirror, R, and which is to be brought to a focus at *a*, giving a neat image of the perforation A at a distance of about eight-tenths of an inch from the lens U, T, and in the same plane as the object which is to be examined. The length of the tube, and the distance of the convex lens from the perforation, may be somewhat varied. The length here given, six inches, being that which it was thought would be most convenient for the height of the eye of the observer above the table. The diameter of the image of the perforation A need not, excepting with lower powers than are here meant to be considered, exceed one-twentieth of an inch.

The intensity of illumination will depend upon the diameter of the illuminating lens, and the proportion of the image to the perforation, and may be regulated according to the wish of the observer.

The compound magnifier, M, consists, as before mentioned, of two plano-convex lenses; the proportion of the foci of these lenses being about as three to one. They are fixed in their cells, having their plane sides next to the object to be viewed, their plane surfaces being distant from each other about one and four-tenths, or one and a half, of the length of the shorter focus. This distance should be varied by trial, until the utmost possible degree of distinctness has been attained, not only in the centre, but throughout the whole field of view.

In order to determine the distance between the plane surfaces of the lenses, I have used the following contrivance. A wire is bent so as to form a spring, to the ends of which two small pieces of plate glass are attached. Between the surfaces of the pieces of glass, is placed the interior cell, or that which carries the lens of the longer focus; and the distance between the exterior surfaces of the pieces of glass is to be measured with a pair of callipers: the cell is then

to be screwed into its place, and the compound cell subjected to the same operation; when the increase of distance between the exterior surfaces of the pieces of glass will evidently be equal to the distance between the plane surfaces of the lenses.

The exterior cell of the compound magnifier should be formed with a flanch, so that it may rest upon the piece that receives it. This is a far more convenient method than screwing, and the magnifiers can be more readily changed.

The lens, U, T, or the perforation, A, should have an adjustment, by which the distance between them may be varied, and the image of the perforation be thus brought into the same plane as the object to be examined. This may perhaps be most conveniently done by two tubes, screwing the one into the other.

A stage, for carrying the objects, furnished with the requisite means for lateral adjustments, is fixed at *a*, between the magnifier and the lens U, T. The adjustment for distinct vision, is applied to the piece carrying the compound magnifier.

For the perfect performance of this microscope, it is necessary that the axes of the lenses, and the centre of the perforation A, should be in the same right line. This may be known by the image of the perforation being illuminated throughout its whole extent, and having its whole circumference equally well defined. For illumination at night, a common bull's-eye lanthorn may be used with great advantage.

With this microscopic doublet, I have seen the finest striæ and serratures upon the scales of the *lepisma* and *podura*, and the scales upon a gnat's wing, with a degree of delicate perspicuity, which I have in vain sought in any other microscope with which I am acquainted.

Before I conclude, I would point out one great advantage that has confirmed me in the preference I have given to the use of a plano-convex lens, properly applied; that is, having its plane side next to the object: namely, that if such a lens should touch a fluid under examination, the view is not only not impaired, but even improved, by the contact of the two media; but if a double convex lens be used, and it should accidentally touch the fluid, which not unfrequently happens, when the lens is of short focus, there is an end of the examination, until the lens has been taken out, wiped, and replaced.

Appendix.

The instrument which has been described, will, of course, admit of many varieties of form; I shall, however, add a description of that which has appeared to me to be convenient, and which is represented in the cut. A brass tube, of sufficient length and diameter, forms the body of the instrument; one end of the tube is closed by a piece having a screw S, by means of which it may be fixed in the top of the box intended to contain the instrument, and which thus forms a support for it. A portion of the tube above this piece is cut open in front for the purpose of admitting light to the small plane mirror R, which is attached to a horizontal axis, passing through the diameter

of the tube. The inclination of this mirror may be varied, by means of a milled head, fixed to the axis on the outside of the tube; the other adjustment at right angles being made, by turning the box of the microscope.

Into the tube, above the opening, a conical piece, E, B, is soldered, into which is screwed a small cylindrical tube, carrying the perforation A, before described. The plano-convex lens, U, T, is fixed in a spring tube, which slides into that which forms the body of the microscope. The position, consequently, of the lens, may be varied, so as to bring the image of the perforation into the same plane with the object to be viewed. A piece of plate glass, about two inches square, or less if it be thought more convenient, is attached to the top of the tube, and serves to support a stage, having lateral adjustments at right angles to each other. The piece into which the magnifiers fit, may be moved by a rack and pinion, and great care must be taken to arrange this adjustment, so that the magnifier may move precisely in the prolongation of the axis of the tube. The tube is divided into two pieces of equal lengths, which screw into each other at the middle; and which, when taken asunder, will allow of the whole instrument being packed in a box, about four inches square.

Supposing the plano-convex lens to be placed at its proper distance from the stage, the image of the perforation may be readily brought into the same plane with the object, by fixing temporarily a small wire across the perforation, with a bit of wax; viewing any object placed upon a piece of glass upon the stage of the microscope, and varying the distance of the perforation from the lens, by screwing its tube, until the image of the wire is seen distinctly at the same time with the object upon the piece of glass.

On employing Disks of Fusible Metal to prevent Explosions in Steam Boilers. *By* M. Gualtier de Claubry.

[From De Moleon's *Recueil Industriel.*]

The fatal accident which happened to a steam boat at Lyons, has caused steam navigation to be held in great disesteem, as well as high pressure steam boilers; and notwithstanding the reasons which have been assigned, on the probable causes of the above accident, yet we see that fears are renewed, and, until more certain means of preservation shall have been brought into use, these fears will be productive of great inconvenience.

The explosion of the boiler of this steam boat, has been attributed to the imprudence of the engineer or his workmen, who, in order to start the boat, loaded the safety valves, to increase the force of the steam. M. Clement thinks, that perhaps in this boiler, as well as in that which burst several years since, at the manufactory of M. Ferrey, at Essone, and which was also constructed by the same engineer, Mr. Steel, the openings of the steam valves were of too small a diameter to give passage to all the steam produced. But whatever may have been the causes of the accident, we should endeavour to prevent

a repetition of it; and here an important question presents itself, which merits the greatest attention; namely, can we find, amongst the various safety valves hitherto employed, one which is calculated to preserve us from all the accidents attending the use of high pressure steam boilers.

We have seen long since, that, owing to various accidental causes, the ordinary safety valves do not always act, so as to ensure safety; and the curious observation of M. Clement, respecting the valves of the blowing machine at Fourchambault, which observation perfectly applies to those of steam engines, has proved, that with safety valves of a large diameter, and under a feeble pressure, but a false security is afforded; as truly so as when their levers are loaded by too great a weight. We must, therefore, recur to other means, in order to avoid those accidents which arise from the too strong pressure of the steam.

The disks of fusible alloys, which melt at the temperature required by the pressure to which we would raise the steam, have, for several years, obtained the approbation of the most enlightened men; and positive experiments have proved that their use would be most advantageous.

Nevertheless, a man of science, whose name is of authority, and to whose opinions we should with pleasure defer, has adopted an opinion of a contrary nature; and which would exercise an unhappy influence, were we to suffer it to pass without examination; it therefore seems proper to provoke a discussion on this important subject, one of the most useful kind, and which may produce results that certainly will benefit science.

These disks of alloy are composed of various proportions of the three metals, bismuth, lead, and tin, and which, according to their relative quantities, melt at particular temperatures; and thus, by a fusion more or less complete, open a free passage to the steam, and hinder the fracture of the boiler, which might otherwise experience too strong a pressure; but the greatest care ought to be taken to insure that these disks should produce their intended effect. They should therefore be composed in such proportions, that they should melt at a temperature but little higher than that at which the steam boiler of the machine ordinarily works.

They should also be placed in a situation well chosen, as it is known that in different points of the surface of the boiler, the temperature is not perfectly equal, and that a disk which would melt at one point, will remain solid in another; and thus it is not sufficient to provide disks which should melt at the temperature indicating a pressure of two, three, or four atmospheres, &c., unless we have also well determined the point at which this pressure and temperature exist. For instance, if the safety valve be placed over the fire-place, or at the extremity of the boiler, it is not likely, that under similar circumstances, the disk should always melt at the convenient time, nor if it be placed in a pipe more or less elevated. It seems that the best position for the disk would be over the fire-place.*

* It was in this position that Mr. Trevitheck placed his safety plugs, in the bottoms of his high pressure steam boilers.—Editor Tech. Rep.

This observation agrees with the opinion of M. Clement, who says, in his course of lectures on the applications of chemistry to the arts, that in pursuing the theoretic idea of adopting the use of the fusible disks, we must not only calculate upon their fusion, but also upon their softening; and he exhibited one to his auditors, in which its change of form was visible, and this before it had become soft.

In order to judge of the defect in this disk, it would be necessary to know, in the first place, whether it had been placed in the most convenient situation; and, secondly, whether it was composed of good proportions; two circumstances which might exert a remarkable influence upon its change of figure. When a fusible disk is subjected to steam, at a temperature nearly approaching to that of its fusion, as the alloys, according to the proportions of which they are composed, soften at different temperatures, some small parts of them experience a liquation, which we see appear in the middle of the surface of the disk, in the form of globules, of which the number continually augments, so as at length to form a swelling, resembling the head of a cauliflower, in the midst of which an opening is produced, which affords an issue to the steam: but if the temperature be raised gradually, the liquation will continue, and bulge out the metal, especially in the centre, where the fusion has taken place, but not towards the edges, and thus form a projecting disk.

[TO BE CONTINUED.]

Danger from the premature explosion of Gunpowder in the Blasting of Rocks, with suggestions as to the means of prevention.

THE deep interest excited by the following letter, induced me to submit the subject to the consideration of a gentleman whom I knew to have had considerable experience in blasting rocks, and in whose science and skill, I have the greatest confidence. As he has favoured me with an answer, which contains very important suggestions, I am happy to lay it before the public, in connexion with the letter of Dr. Catlin. I have added also, some suggestions of my own.

B. SILLIMAN.

I. *Letter of Dr. Catlin.*

Haddam, Con. August 25, 1829.

TO PROF. SILLIMAN.

DEAR SIR,—Being desirous to promote the welfare of my fellow citizens, and to render the situation of those engaged in a hazardous employment, as safe as the nature of the case will admit, I take the liberty to address you for the purpose of obtaining some information, on a subject important to mankind.

It is undoubtedly well known to you, sir, that a large number of men in this place, are engaged in the quarrying of stone. They are under the necessity of using large quantities of gunpowder, for the purpose of liberating the rocks, and injuries have not unfrequently

been received, from premature explosions. But till recently, the injuries have seldom been serious, and the explosion has readily been accounted for, and has generally, perhaps always, except in the last case that occurred, been owing to the carelessness of the operator. The lives of two valuable young men of this place, have within a few weeks, been destroyed by explosions, which has alarmed us; the last case particularly, as we are unable to discover the manner in which the powder became ignited. I will relate the circumstances: the hole which was charged was eighteen or twenty inches deep, and about three in diameter, and was made by drilling into a solid rock. The spindle used was made of copper, and that it might be easily drawn, it was oiled; a wad of dry tow was first put down, with a wooden rammer, and followed by two wet wads, pushed in with the same instrument. The hole was then filled up a few inches with gypsum, by putting in a little at a time, and pounding it down forcibly with an iron tampering bar, held in the hole and struck upon with a hammer. The spindle was then withdrawn a little, by placing the tampering bar through the ring at the upper end of the spindle, holding one end in the hand, and striking under the other with the hammer; after this, the workman proceeded to tamper down as before, and again drew his spindle as at first, but thinking that it was not withdrawn sufficiently, he gave another blow, and it exploded. The end of the tampering bar, (as is supposed,) struck in his right eye, fractured the orbitar plates of the os frontis, and destroyed life in thirty-six hours.

Now, sir, if you can inform me how the powder became ignited, and how the danger may be avoided in future, you will confer a benefit on all those engaged in quarrying, and much oblige,

Your servant,

BENJAMIN H. CATLIN.

II. *Letter of Mr. Blake.*

Whitneyville, September 5, 1829.

TO PROF. SILLIMAN.

My dear sir,—In blasting rocks, as you know, it is not an uncommon thing for explosions to take place before the charging is completed. Almost every year some of our numerous newspapers give accounts of such premature explosions, attended with fatal consequences to the operators. The cause of the accidental ignition of the powder in these cases, is sometimes clearly indicated by the known circumstances of the case, and at others it can only be referred to the unknown circumstances, which may have attended the operation. I have read with attention the letter on this subject, which you did me the honour to refer to me, which was addressed to you by Dr. B. H. Catlin, of Haddam, giving an account of an accident of this kind, and soliciting information as to the cause of the ignition of the powder, and the means of avoiding similar accidents in future; and shall now with pleasure proceed to state to you my views of the subject, as you desired.

The method of charging the rock, in this case, as minutely describ-

ed by Mr. Catlin, was that which is now most generally practised, and it is perhaps the only method that was in use twenty years since. The workman appears to have used more than the ordinary degree of caution; and I cannot see that there was any thing in the case to produce explosion, which is not liable to exist, in every case, in which this method of charging is practised. In the Journal of Science, vol. XIII. p. 161, are given the results of some experiments tried by M. Aubert, which go to show that violent shocks and percussions, between any two hard substances, may occasion the disengagement of sufficient heat to inflame gunpowder; and it is well known that violent *attrition* is still more favourable to the disengagement of heat than percussion. To both of these the process, as described by Mr. Catlin, is evidently in some degree liable. In tamping down the first quantity of gypsum, which was put in next above the wad, the irregular pressure of those pieces which were in contact with the wad, would be very liable to force the wad down on one side of the hole, or in the centre, which would cause the powder to be thrown up on the other side, or on all sides. The spindle is usually inserted into the powder on one side of the hole; consequently the wadding would not be likely to close the hole entirely around the spindle, and the powder would be, therefore, particularly liable to be thrown up around the spindle. By proceeding with the tamping, this powder would be brought in close and hard contact with the spindle, and in withdrawing the spindle in the manner mentioned by Mr. Catlin, would be subjected to violent attrition, between the spindle and the gypsum, or between the spindle and the rock. Whether this was or was not the precise cause of the explosion, cannot perhaps be determined; nor will it be important to know, if, without this knowledge, satisfactory information can be given in regard to the manner in which the recurrence of similar accidents may be prevented in future.

About twenty years since, another method of charging a blast was proposed and circulated in the newspapers, which, since that time, has been practised to some extent in different parts of this country. This method may be briefly described as follows, viz. After putting in the powder, take a rye or wheat straw, which is long enough to reach from the powder to the top of the hole, and having filled it with powder, insert one end of it into the charge; after which put in a small quantity of wadding, and then fill up the hole with coarse dry sand, simply poured in without any ramming.

When about ten years since my attention was turned to blasting, I made a trial of this method, with great success in some cases, but without any effect in others. I soon found that when the hole was *deep*, the effect was not only certain, but also more powerful than when charged in the old method. But when the hole was shallow, the sand would generally be thrown out without producing any effect on the rock. When the depth of the sand above the powder is not less than ten times its diameter, I have never known it to be thrown out. In all such cases, therefore, I can from experience recommend this method as one which is perfectly safe and sure, and at the same time more expeditious and more effectual than the old method.

Since my attention has been drawn to this subject by Mr. Catlin's letter, an equally safe method has occurred to me, of securing a blast in holes of less depth. This method is as follows; viz. Having put in the powder, and inserted into it, on one side, the straw filled with powder, as directed above, put in a small quantity of wadding and press it compactly down; then make a cone of wood, the diameter of whose base is a little less than the smallest diameter of the hole, and whose height is a little less than the distance from the top of the wad to the top of the hole. Set the base of this cone on the wad, and then keeping the vertex in the centre of the hole, fill in around it with coarse dry sand. If the hole be very shallow, the sand may be pressed down around the cone with a small wooden rod, but if the length of the cone be eight or ten inches this will be unnecessary.

For the purpose of testing this method, before I proposed it to you, I have, within the last week, made seven trials of it, six of which were successful. The failure of the other, I attributed to the circumstance that the cone was so large at the base as to bind on the sides of the hole. The same hole was afterward charged, using a smaller one, and the blast was effectual.

I have spoken of the piece of wood to be used in this method of blasting as a *cone*. Strictly speaking, however, its form should not be that of a true cone. In a cone, the areas of the sections which are parallel to the base, are as the squares of their distances from the vertex; but the proper form for the pieces of wood, is that in which these areas are not in the *duplicate*, but in the *simple* ratio of the distances from the vertex. This gives the form of the true *paraboloid;* and to this form the workman, in making the piece, should certainly approximate as nearly as convenient; particularly as it respects the main part of the length, from the base toward the vertex. Near the vertex the form will not be so important. It is more conveniently formed, and is perhaps better, to *terminate* in a conical point, rather than in the more obtuse form of the paraboloid.

I here give a longitudinal section, showing on a small scale, nearly the form of the pieces which I used in my experiments.

It will be proper to remark here, that no very great degree of precision will be necessary in forming the pieces, particularly for holes which will receive one as long as eight or ten inches. When the workman has formed a just conception of the proper form, he may make one with sufficient precision, for any depth of hole, with no other instrument but a common axe. The pieces, especially when not more than five or six inches long, should be made of hard seasoned wood. When once made, they may sometimes be used several times in succession, as they will not often be thrown to a great distance; sometimes not even out of the hole. In my experiments I used one piece three times, and another twice.

Though the time occupied in charging in this way, is somewhat

more than it takes to charge in those cases where sand alone may be used, it is still much less than is required to charge in the old method, as described by Mr. Catlin. Should this method, on further trial, be found to be sure and effectual, it will afford as full a remedy as can perhaps be expected, for the hitherto hazardous nature of the employment. With the most respectful consideration,

I am sir, your friend and servant,

ELI W. BLAKE.

III. *Letter of the Editor to Dr. Catlin.*

Dear sir,—It is perhaps hardly necessary to add any thing, after the able and clear instructions given by Mr. Blake. But as people are more prone to go on as they have been accustomed to do, than to adopt new modes, although improved ones, it may not be amiss to say, that Mr. Blake's method appears to me to embrace all the desiderata, both theoretical and practical, which the case requires.

1. You are aware that *the explosion of gunpowder arises from the instantaneous production of a vast quantity of gases*, which being also expanded by the red heat, cannot be confined, and of course, when not permitted to escape, rend their enclosure. With a given quantity of powder, the tendency of the gases to rend the enclosure, is increased, in proportion as we increase the resistance which we present, tending to prevent their escape; and we modify this resistance, to suit our views, in different cases. In a gun, we add a wad, not only to retain the powder, but to cause its more instantaneous combustion, and to confine the action of the gases in that direction, to the bullet; it is not our object to do more, and if our charge is too great, or the wadding is rammed down too hard, or there is upon it too great a load of metal, the reaction is so violent as to burst the piece. This is a rare accident, considering how many discharges are made by careless people; and we are scarcely aware how much the force of an explosion is increased by even slight resistance. A train of gunpowder laid on a board, burns, as we know, with so little rapidity, that we easily walk or run faster than it goes; but, if another board be laid over the train, and weights placed upon it, although still open at the sides, the powder then burns with amazing rapidity. Powder merely flashes in the pan of a musket, but the same powder placed in a quill, burns vehemently; still more fulminating mercury, which also flashes, (although with intense brightness,) when fired in a heap, explodes with great violence, in a quill.

2. *Our object, then, is to repress the force to such a degree as to accomplish our purpose*, which, in fire arms, is to give velocity to a ball; but, in the case before us, it is to rend asunder the surrounding matter. In the old method of blasting rocks, this was most effectually accomplished, by ramming down pounded brick upon the wadding. This closed the hole so thoroughly, that commonly, the brick would remain undisturbed by the explosion, which, of course, spent itself upon the rock, and tore it asunder.

In blasting logs, also, the same object was attained, by driving a wooden pin into the hole above the wadding; and here again the pin often remained in its place, after the explosion which burst the log.

3. But, *in blasting rocks, painful experience has shown, that great danger of premature explosion is encountered, whenever firm substances are made use of to close the canal above the powder;* and multitudes have been killed outright, or dreadfully mutilated by these casualties.

4. *The ingenious remedy, first proposed by the French, and employed, if I mistake not, by the engineers of Napoleon, in constructing his famous roads through the Alps, removed the danger of explosion, but was not in every case effectual.*—As the success is not universal, and the reason and remedy were unknown to the workmen, this method seems not to have been generally adopted in this country. Mr. Blake has, however, given us the rule, by which the desired effect may be rendered certain, and there can be no hesitation in applying it, as is indicated by him, when the hole is bored to a certain depth.

5. *The method of Mr. Blake combines all the advantages of the French mode, with another important one, which is peculiar to his contrivance.*—It is equally safe with the French method, (both are perfectly safe,) and Mr. Blake's supplies the only deficiency in the French mode. The latter was effectual, evidently, because the resistance afforded by the column of sand, when of a certain depth, was sufficient to produce the necessary reaction upon the rock; perhaps the movement which would be given to the sand, by the first expansive lift, when the powder was kindled, would even facilitate its thorough and sudden inflammation, by giving room to the flame to dart at once, into, and among the grains; while the pressure would force the flame to pervade, instantaneously, the whole magazine.

In Mr. Blake's mode, this advantage is equally attained, and when the wooden stopper begins to rise, in consequence of the expansive effort of the gases, it is immediately wedged by the sand, which is crowded between it and the walls of the cavity; more sand presses down from above, and thus a firm resistance is created, by the very effort which the explosion makes to overcome it. It is a peculiar species of valve, which operates at the moment when it is wanted, and not before. It appears to me to combine, in a sufficient degree, all the advantages of the early, effectual, but dangerous mode of ramming in brick fragments; of the other more recent use of gypsum, and other soft substances, and of the filling with sand. Should the experience of the quarrymen confirm the *certainty* of the method, *its safety* being perfect, this new mode of blasting will prove to that dangerous branch of the arts, what the safety lamp has already proved to the coal miners.

Should any practical difficulties occur, such as are frequent in new undertakings, however promising, it is to be hoped that the attempt will not be precipitately abandoned, as it is highly probable that the united efforts of science and mechanical skill will overcome them.

6. *A few remarks on the theory of these accidental explosions,* and I shall have done. To any one acquainted with chemistry, it will not appear very extraordinary, if we reason from the nature of the elements concerned, that there should be cases in which gunpowder explodes without a red heat.

Gunpowder consists of highly inflammable bodies, charcoal and

sulphur, most intimately blended with three times their weight of nitre. Nitre contains more than half its weight of nitric acid, and nearly four-fifths of this is oxygen. Oxygen is the great agent in combustion, and it is rather wonderful than otherwise, that it should lie in close union with dry inflammables, without acting upon them; it is the tiger, reposing peacefully with his prey, and attacking it only when he is roused: the proper stimulus to bring on the action in gunpowder, is a red heat, but it is clearly possible, that much smaller degrees of heat may answer the same purpose, and such degrees are often rendered sensible, by mechanical action. Chemistry abounds with similar cases. If, as has been repeatedly done, chlorate of potash be substituted for nitre, in the composition of gunpowder, no well informed man would dare to ram down a cartridge made of it, much less to charge a rock with it in the ordinary way; it would inevitably explode, by a very gentle pressure; as was fatally experienced at Essone, in France, where, during the trituration of a gunpowder, of this description, although it was conducted with all possible care, an explosion killed several persons.

Fulminating mercury, and fulminating silver, are still more irritable, and the latter, when thoroughly dry, will not permit even the weight of a knife blade to rest upon it, without inducing a violent explosion; in a quantity equal to a common musket charge of gunpowder, it would, probably, be always fatal.*

7. It is not, therefore, theoretically improbable, that the heat necessary to the action of the oxygen upon the combustibles in gunpowder, may be evolved by pressure, and the particles may also be brought within the distance of effectual attraction, by the blow applied in ramming down, and thus it is possible, that the action may come on, even when there is no spark.† May not some of the premature explosions of cannon and other fire arms be attributed to similar causes, especially when the piece is hot, in consequence of previous firing, although there should be no spark?

All these views conspire to render it highly desirable that Mr. Blake's method should prove successful, and I shall be much interested to learn the result, which, after sufficient experience, I shall hope that you will communicate to the public. I remain, respectfully, your very obedient servant,

B. Silliman.

[*Silliman's Journal.*

On the Economy of using Alcohol, Ether, &c. in the working of the Steam Engine. By Mr. Ainger.

Mr. Ainger, in a notice on the "Economy of the Steam Engine," made to the Royal Institution of Great Britain, at their meeting,

* I had nearly lost both my eyes in 1811, by the explosion of fulminating silver, which took place in consequence of gentle pressure, even when it was under fluids. The particulars of the accident are related in Dr. Bruce's Journal, vol. I.

† As in the cases that occurred in France, and which had been cited by Mr. Blake.

February 19, 1830, alluded to the misapprehensions which had at various times existed, as to the saving of fuel which would result from substituting ether or alcohol for water, as the vaporizable material; and he endeavoured to show, that a very simple calculation applied to the known facts, in regard to those substances and their vapours, would have prevented those misapprehensions, and would, indeed, have furnished the same results as have been obtained from experiment. The reasons usually assigned for proposing to use these liquids instead of water, have been the lower temperature at which they assume the state of vapour of a given elastic force (alcohol, for instance, boiling at about 170°, and ether at about 100°;) and also the smaller latent heat of their vapours, as compared with steam. The boiling point of a liquid, and the latent heat of its vapour, form, however, only a small part of the consideration required for calculating its economy. The cost of a certain quantity of force derived from a given bulk of liquid, depends on the boiling temperature, the specific gravity, and the specific heat of the liquid, and, on the latent heat, the actual weight, and the specific gravity of the vapour. These being known, the relative costs of a certain quantity of power derived from two or more liquids may easily be deduced, as in the following comparison between water, alcohol, and ether.

It may be assumed, that these substances are all supplied to the engineer at the same temperature, say 50°. To raise them to their boiling points, they will require the following additions:

	Boiling Point.
Water - -	212 — 50 = 162
Alcohol -	170 — 50 = 120
Ether - -	100 — 50 = 50

Multiply these numbers by the specific gravities of the liquids, respectively.

	Specific Gravity.
162 ×	1000 = 162,000
120 ×	800 = 96,000
50 ×	740 = 37,000

These results would require to be multiplied by the specific heats of the three liquids; but, as the specific heats are not very perfectly ascertained, and, as far as they are known, do not appear to differ very considerably; and, further, as the cost of heating the liquid forms a small part of the whole expense, the specific heats may be safely neglected, leaving the numbers, 162, 96, and 37, to represent the expense of elevating to the boiling temperature equal volumes of water, alcohol, and ether.

The cost of vaporizing them will be given by multiplying the actual weights (represented by their specific gravities) of the three liquids by their latent heats, which are about 1000, 450, and 300.

	Weight.	Latent Heat.
Water -	1000 ×	1000 = 1000
Alcohol -	800 ×	450 = 360
Ether -	740 ×	300 = 222

Add these numbers to those representing the cost of heating up to the boiling points, respectively:

162 + 1000 = 1162 Water
96 + 360 = 456 Alcohol
37 + 222 = 259 Ether

then the last results will express the whole cost of vaporizing equal bulks of the liquids in question; the advantage, so far, appearing greatly in favour of the ether and alcohol, as compared with water. But it is now necessary to introduce another element into the calculation, namely, the specific gravity of the vapour, or the volumes of vapour produced from equal volumes of liquid. These are nearly as the following numbers:

Water - - -	1700
Alcohol - -	610
Ether - - -	300

That is to say, one cubic inch of water becomes about 1700 inches of steam, at atmospheric pressure; and single cubical inches of alcohol and ether become 610 and 300 inches, at the same pressure. The quantity of power is obviously as the bulk of the vapour, and the cost is, of consequence, inversely as that bulk. If, therefore, the cost of vaporizing be divided by the bulks of vapour respectively, the quotients will represent the relative expense of equal units of power derived from the three liquids.

1162 ÷ 1700 = .6714 Water.
456 ÷ 610 = .7475 Alcohol.
259 ÷ 300 = .8633 Ether.

From which it appears, that, independently of the original cost of the liquid, supposing indeed that alcohol and ether were supplied spontaneously, as accessible, and at the same temperature as water, even then, water would be the most economical source of power.

From this it appears, that the temperature at which a liquid vaporizes, and the quantity of latent heat absorbed in the process, form no criterion of its eligibility for the production of mechanical force; and that, therefore, there is no reason at present to expect that power can be obtained from liquid carbonic acid gas, or any other of the gases liquefied by Mr. Faraday, more cheaply than from water, merely because of the low temperatures at which they become highly elastic. Analogy, it is evident, would lead to a conclusion exactly the reverse, and would induce an expectation that the vapour of mercury, or even of metals vaporizing at a much higher temperature, would furnish the most economical motive power.

Mr. Ainger then described a mode of increasing almost indefinitely the power, or, in other words, of decreasing almost indefinitely the expense of the steam engine, which has not hitherto been suggested, and which appears to require for its realization, only the discovery of a succession of liquids, whose boiling points should differ about 100° of Fahrenheit; whose nature should not alter by repeated distillation; and which should exert no injurious action on the substances composing the machinery of the steam engine. The difficulty of finding such a series of liquids is probably insuperable; if it were not so, there can be little doubt that the cost of steam power would be susceptible of an immense reduction. If, for instance, a suc-

cession of liquids could be obtained, whose boiling points were 612°, 512°, 412°, 312°, and 212°, and if the furnace were applied to the first, and its vapour were employed to work a condensing engine, it is clear that the vapour which was condensed at 612°, could be made to evaporate the second liquid, by condensing the first on the surface of the vessel containing the second, the vapour of which would, in its turn, work a steam engine. The condensation of the second vapour at 512° might, in like manner, evaporate the third liquid which boils at 412°, and so on, till the water which boils at 212° was evaporated, and which might be condensed by injection in the usual way.

It may perhaps be thought that a cooling surface at 512° will not sufficiently reduce the tension of a vapour at 612°, to leave any effectual difference between the pressures on the two sides of the piston; but it must be recollected, that a depression of 100° reduces the elastic force of a vapour produced at 612°, as much as of one produced at 212°. The elastic force of common steam at 112° is equal only to 2¼ inches of mercury; the elastic force, therefore, of the vapour produced at 612° would, when cooled to 512°, be also equal only to 2¼ inches of mercury. There is, it must be confessed, a difficulty in condensing by mere contact with a metallic surface, as compared with condensation by an injection: but this difficulty would, in the proposed case, be much less than in the various schemes which have been projected to use alcohol, ether, and liquid carbonic acid, because in the former it is proposed to cool a less easily vaporized substance by one more easily vaporized; whereas, in the latter cases, water, which has been the intended cooling material, is less easily vaporized than the substances it is required to cool; a circumstance obviously unfavourable to the production of the effect. But for this difficulty, it is probable that the heat employed to vaporize water might, by the condensation of the steam, be transferred to alcohol, and from this again to the ether; but the question then arises, how is the heat to be abstracted from the ether; we have no other means than the contact of a vessel containing cold water, a means which is found insufficient for cooling common steam, and which would, therefore, be doubly inefficient in cooling the vapour of ether. These considerations will suggest other difficulties in the construction of engines to use alcohol and ether, beyond the absolute defect of economy, which has been before explained.

[*Brande's Quarterly Journal.*

On the Formation of Steel by means of Silica.

It is well known to chemists, that silicum combines freely with iron, and also, that certain persons have considered silica a substance which possesses in common with carbon, and perhaps boron, the power of converting iron into steel. M. Boussangault, if we mistake not, put forth some views, in which he considered silicon as the constant agent in the production of steel.

The Editor of the *Recueil Industriel* has described several cases, in which the presence of silicon appears to have an important influence of this kind. Some time since, Dr. Eynard of Lyons, having put some files into a mixture of five parts of water with one of sulphuric acid, was astonished when he took them out, to find, at the bottom of the glass vessel in which they had been placed, a grayish white and glairy substance. This, being collected and dried, proved to be silica.

In 1782, MM. Perru of Neufchatel established a manufactory of steel cylinders at Lyons. These cylinders, which were highly polished, and so hard as to be untouched by the file, had been fused, it is said, with *silica*. They have never been imitated. A pair of these cylinders, 5 inches in diameter, sell at this time for 2400 francs.

Some years since, a person of the name of Ranquet, of Lyons, formed vessels of white cast iron of extreme hardness. M. Culhot manufactured cylinders from the fragments of these vessels, and the cylinders were of such hardness, it was impossible to shape them by cutting instruments, so that they could be worked only by emery, and similar substances, occupying months for the purpose. This person made a secret of his process, but it is said, used no charcoal in his process.

M. Eynard found silica in cast iron, but not in forged iron; its occurrence in the former, or rather the presence of silicon, is a well known circumstance.

Upon these facts, the Editor founds some earnest recommendations to those who have the opportunity of ascertaining whether the cementation of iron without charcoal, but with silica alone, would produce steel, and in what proportions the silica ought to be mixed, to obtain a very perfect and hard steel; there are also other points urged, which are either already upon the minds of metallurgists, or are naturally suggested by the two above.

[*New Edin. Philos. Journ.*

Copal Varnish. By J. J. Berzelius.

Copal reduced to coarse powder, and watered with caustic liquid ammonia, swells, and is converted into a gelatinous mass, which is entirely soluble in alcohol. To effect this solution, which makes a very beautiful varnish, liquid ammonia is to be added, by degrees, to pulverized copal, till the swelling ceases, and it becomes a clear and consistent mass. It is then heated to 35° cent., and introduced in small portions at a time, to alcohol of 8, having a temperature of about 5° cent., shaking it well after each addition. A solution is thus obtained, which, after depositing an insignificant portion of sediment, is absolutely colourless, and as clear as water.

[*Journ. de Con. Usuelles, Oct.* 1828.